

BLUEPRINT FOR TOMORROW

By Charles F. Kettering

POPULAR MECHANICS

MAGAZINE

WRITTEN BY



REGD. TRADE MARK/GREAT BRITAIN/NO. 40438

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JAN.

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For many a
Merry Christmas
GIVE
WAR BONDS

SEE PAGE 6





"Electronics?"

***SURE! We've had it in
our home for twenty years***



You're not being fooled by what you've read and heard about the wonders of Electronics. We have been enjoying the miracle of Electronics these many eventful years. *Where? How? Why*—that radio in our living-room and the one in our car is an electronic device. So the next time anyone talks to you about Electronics . . . you just be smart and say, "Sure, I have an electronic device right now . . . it's my radio."

Motorola Radio engineers who built those fine pre-war home and car radios were pioneers in Elec-

tronics. They have added much to their wealth of electronic knowledge in the development and production of Radar and Radio Communications Equipment for our Army and Navy. And for the duration, the production of these weapons for Victory will be Motorola's full time job.

We cannot tell you what the post-war Motorola Radio will look like, but we can tell you that it will look and sound swell. Meanwhile, let's keep all that Victory stuff coming off the production lines! *And let's buy all the War Bonds we can!*



For the continued development and production of Radio Communications and other special Electronic equipment for our Armed Forces, the Motorola organization has been awarded two stars for their Army-Navy "E" Flag. Motorola is proud of the part it has been privileged to play in the speeding of Victory.

Motorola
GALVIN

RADIO
FOR HOME & CAR

MFG. CORPORATION - CHICAGO - ILLINOIS

WARTIME ANNOUNCEMENT!

Revolutionary RADIONICS Product of Great Importance

For All Hard of Hearing — their Friends and Families



Zenith Radio Corporation

CHICAGO

OFFICE OF
E. F. McDONALD, JR.
PRESIDENT

To: Manpower Authorities, Employers, Physicians,
Parents, Teachers and Hard of Hearing.

Our country's manpower crisis calls for everyone's maximum efficiency. Since I lost the hearing of one ear in an accident twenty years ago, I have been acutely conscious of the handicaps of the hard of hearing. While pioneering in radio I have for some years directed Zenith's research toward development of the best wearable hearing aid that science could produce.

My own company has spent millions, the radio industry tens of millions for research. This research has been paid for by scores of millions of purchasers of radio sets.

We, with this technical knowledge and engineering skill, now bring to the hard of hearing a new precision aid — the ZENITH RADIONIC: an instrument of the highest quality.

A hearing aid is essentially a part of a radio receiver. It wires the human body for sound. It is composed of a crystal microphone and parts of a radio receiver set reduced to miniature size and manufactured with watch-like precision. For many years it has seemed to me incredible that the public could buy a complete radio receiver for \$29 or less with which they could hear the words whispered in Europe, Asia, or South America, but people with deficient hearing have paid \$100 to \$200 for a comparably good hearing aid to hear the human voice across the room.

Zenith's facilities and methods for precision mass production of radio sets, Radionic devices, etc., enable it to bring this superb hearing aid within the reach of all.

Eye-glasses, like hearing aids today, were once the luxury of the few. What the optical companies have done to make the finest spectacles available to everybody at low cost, Zenith is now prepared to do for the hard of hearing — to bring with the aid of modern radionic science a highly perfected hearing aid within the reach of the masses.

ZENITH RADIONIC — low cost battery upkeep wearable hearing aid — complete with miniature radio tubes, crystal microphones and batteries — will sell for \$40 — about one-quarter of the price of the better vacuum tube instruments of today. Hereafter no one, child or adult, need be without a hearing aid because it is too high-priced. There are ten million people, of whom over three million are children in our schools, who are hard of hearing.

Even if Zenith never makes a dollar at this low price, it is willing to take its pay in the good will of the hard of hearing, their families and their friends. Thus begins a revolution in hearing aids — a revolution to "lower the cost of hearing" within the reach of all.

E. F. McDonald, Jr.

President,
Zenith Radio Corporation

TO PHYSICIANS: A detailed scientific description will be sent upon request. Further technical details will appear in medical journals.

★

There are cases in which deficient hearing is caused by a progressive disease and any hearing aid may do harm by giving a false sense of security. Therefore, we recommend that you consult your otolaryngologist or ear doctor to make sure that your hearing deficiency is the type that can be benefited by the use of a hearing aid.

★

.....
The Zenith Hearing Aid can be supplied only by your Zenith franchised Optician or Optometrist (no home calls or solicitations).
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Write for Free Descriptive Booklet
ADDRESS DEPT. PM-1, HEARING AID DIVISION
ZENITH RADIO CORPORATION • CHICAGO 39, ILLINOIS



JANUARY, 1944

This One



PHFW-B06-HFZQ

1A

LET'S GET GOIN'!



**DOUBLE YOUR MONEY BACK
IF YOUR CAR FAILS TO START
WITH CASITE IN THE CRANKCASE!**

★ Don't wear out your precious battery on a hard-to-start motor these cold winter mornings. Add Casite to the crankcase and get summer starting every day, all winter long.

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We Guarantee

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Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

January, 1944

Vol. 81, No. 1

Next Month

ROLLING swiftly, smoothly along wooden rails, the Diesel-driven freight train approaches a trestle from which an arctic spring flood has washed out a 100-foot gap. Halting at a highway crossing, the engineer retracts steel pilot wheels and steers his rubber-tired engine and cars along the road. This is the rail-and-road line to Alaska projected in the February issue by Col. E. S. Evans, industrialist who supervised overseas loading for the U. S. Army in the last war. He regards Alaska as the new frontier, proposes to span mountains, ice and muskeg with auto-railers driven on "floating" wooden tracks.

Where Oxygen Ends

BACK in the covered wagon days of the west, the pioneers toted six-shooters for protection. This is the decade of the covered wagon in the substratosphere, and the pioneers wear oxygen masks and electric suits for protection. A February feature, "Up Where the Oxygen Ends," describes the acute tummy-aches, delirium, and aero-embolism that you, a "deep-air" animal, would suffer four miles up, and how our pilots survive it.

Mr. Fix-It With Wings

ONE Boeing engineer flew 2,000 miles to salvage parts from wrecked bombers. A Pratt & Whitney factory representative had to chase a flight of planes 7,000 miles to make modifications. Airplane doctors from American plants are performing operations at battle fronts around the world. Read about them in "Flying Trouble Shooters" next month.

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Your Victory Home

THERE has been a lot of loose talk and glib prophecy about the palace you'll live in after the war. Next month a Purdue University housing authority gets down to earth in an article discussing "Your Victory Home." Since you'll have to pay for it, he suggests some improvements that should be available at your price—simple radiant-heating units, fluorescent paints that will require less electricity for lighting, new waste disposal systems, shop-assembled wiring systems, kitchen stoves that won't waste two-thirds of the heat; and if you can afford it, summer cooling equipment.

Daredevils of the Deep

PRECARIOUS is a mild word. That steel cask the Navy diver stumbles over on the sunken destroyer's deck may turn out to be a depth charge itching to go off. His hands may freeze with more than cold as he feels the nose of an unexploded torpedo. Hot air from tanks in a tropic sun may cause him to swoon 100 feet down, arctic air may freeze his lifeline. For a thrill, read next month's story of Navy divers.

Published monthly by POPULAR MECHANICS COMPANY, 200 East Ontario Street, Chicago (11), Ill., U. S. A. Single copy in the United States, 25 cents; subscription rates in United States and possessions, and countries of the Pan-American Postal Union, \$2.50 a year. Single copy in Canada, 30 cents; subscription rates, \$3.00 a year. To all other countries add \$1.00 a year over United States prices for overseas postage. If you plan to move, notify us at least 60 days in advance so you will not miss an issue. Give both old and new addresses. Entered as Second Class Matter, September 15, 1903, at the Post Office at Chicago, Illinois, under Act of March 3, 1879. Entered as Second Class Matter at Post Office Dept. Canada.

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slow starting is tough
on you ... here's what
it does to that precious
automobile engine of
yours ...

Slow starts are annoying to you—but they are more than annoying to your engine. With the oil drained off from the bearing surfaces of the cylinder walls of the engine—you step on your starter. Metal rubs against metal—that means excessive cylinder wear. **WHAT TO DO?** Add Pyroil—just 1 ounce to 5 gallons of gasoline (also put 1 pt. of Pyroil in the crankcase). It provides a cylinder wall lubricant that stays put on the cylinder wall. That means quicker starting—that means less wear on the engine—and your nerves. Put it in today. You'll notice the difference—and so will your car.

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**"I was one of the guys who helped prove that we
could build synthetic tires like that"**

**"Me and my old jalopy
back home took part in that
80,000,000-mile road test
months before Pearl Harbor"**

"Sure!" said the sergeant, "I picked up a set down at Brown's Service Station. He said it was a test B. F. Goodrich was making. Those tires were more than 50% synthetic rubber—Ameripol, I think they called it."

"Well, it turned out that a lot of other people with cars had been in on the test, too—and all together we rolled up 80,000,000 miles. I guess we got a few things started in the synthetic line."



We're no longer building those early passenger car tires in which approximately half the rubber was synthetic. In today's tires, under the Government rubber program, more than 99% of the rubber is Government synthetic—"GR-S."

But the 80,000,000-mile road test gave us a three-year head start in testing tires made with synthetic rubber—under actual driving conditions. It was of vital importance to the whole synthetic rubber program.

Can you get synthetic tires today? Perhaps, if you qualify. But our fighting forces still need every ounce of rubber they can get. Help them by making your present tires last!

In war or peace
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A few of the many companies that helped make this test

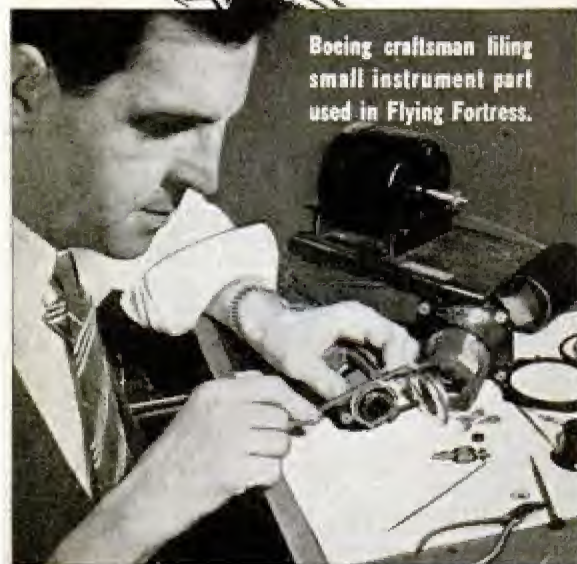
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Boeing craftsman filing small instrument part used in Flying Fortress.



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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.

TO THE MAN WHO WANTS SUCCESS

after the WAR!

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The Magic of Mind

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It is time you realized that the rites, rituals and practices of the ancients were not superstitions, but subterfuges to conceal the marvelous workings of natural law from those who would have misused them. Telepathy, projection of thought, the materializing of ideas into helpful realities, are no longer thought by intelligent persons to be impossible practices, but instead, *demonstrable sciences*, by which a greater life of happiness may be had.

One of America's foremost psychologists and university instructors, says of his experiments with thought transference and the powers of mind—"The successes were much too numerous to be merely

lucky hits and one can see no way for guessing to have accounted for the results." *Have you that open-minded attitude of today which warrants a clear, positive revelation of the facts of mind which intolerance and bigotry have suppressed for years? Advance with the times; learn the truth about your inherited powers.*

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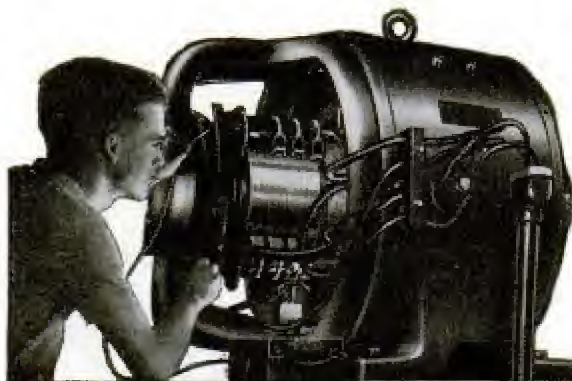
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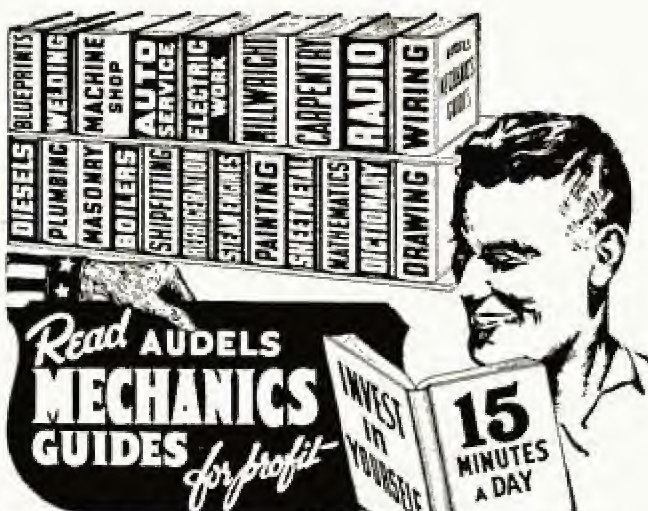
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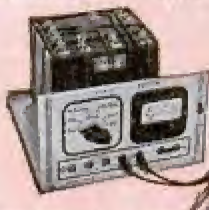
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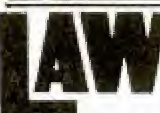
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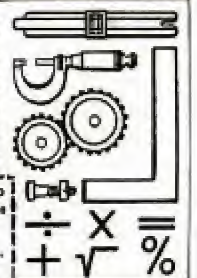
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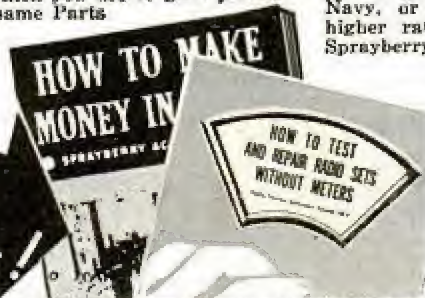
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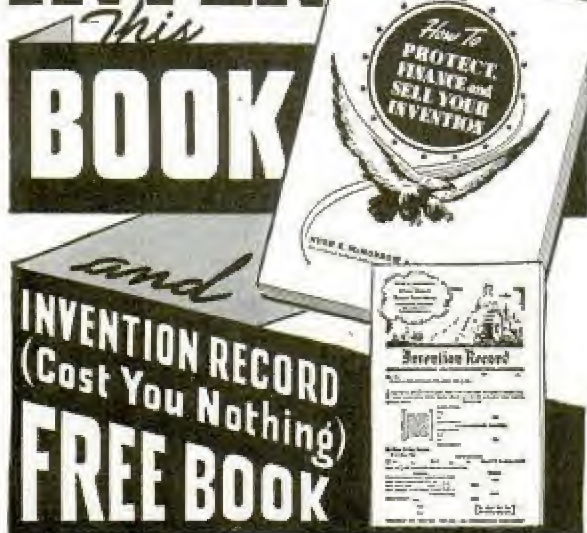
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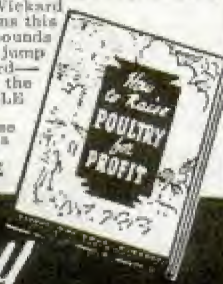
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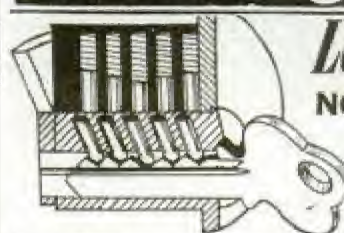
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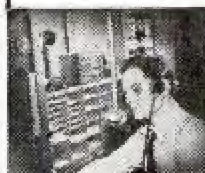
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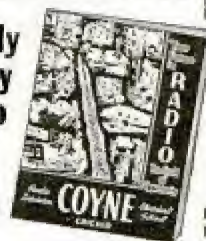


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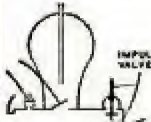
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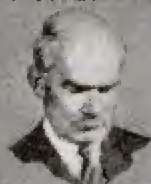
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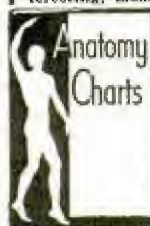
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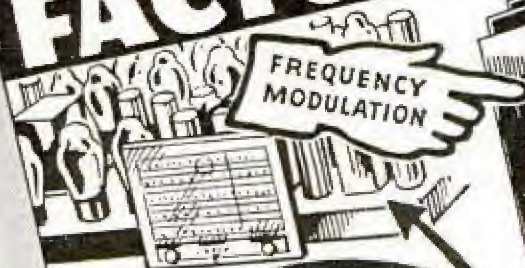
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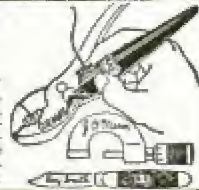
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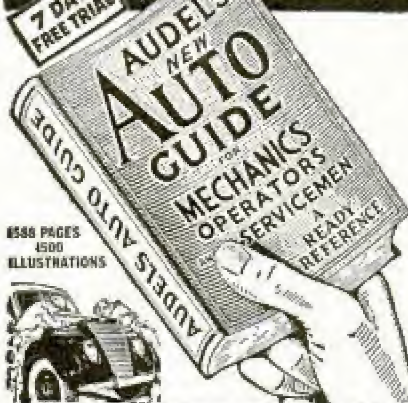
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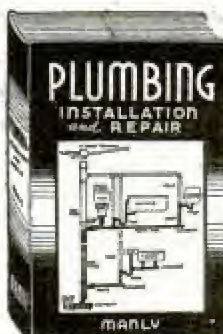
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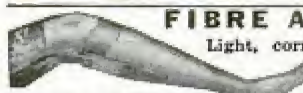
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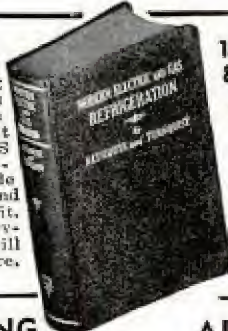
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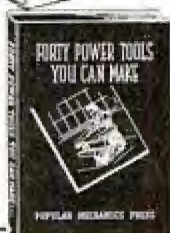
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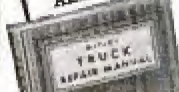
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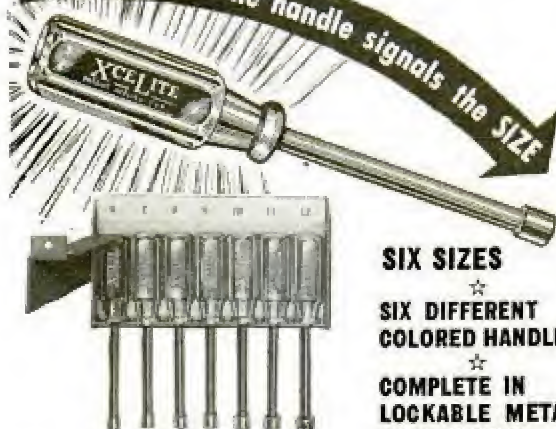
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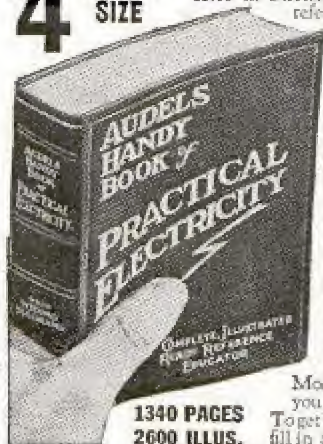
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This is the day I've looked forward to since I was seventeen . . . this is the day I win my wings.

Mom and Dad are waiting there. Dad's standing tense and straight and tall, and his face looks proud and grim, as though the General were talking to him.

"...they tell me you're hot pilots and navigators and bombardiers. And it is well you are..."

As we marched in, Mom waved and I caught the white flutter of her handkerchief out of the corner of my eye. In a moment or two she's going to cry—just a little—like she did the night we talked it all out, she and Dad and I, when I told them I wanted to fly.

"... to your families, I say—ours is the safest military flying of any of the world's air forces."

And now here on the parade grounds, with the shadows falling and the bright flag whipping in the sky, I remember Dad said, "Son, your Mother and I won't stand in your way. If this is what you want to do—do it with all your heart and soul and God be with you. I wish I were your age—so I could fly and fight."

"And I say to you cadets, get the enemy in your sights and let him have it..."

Now, in just a minute, we'll right face and walk up to the platform under the flag. And the General will hand me the parchment, and then he'll pin silver wings on my blouse and return my proud salute.

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Thinking of all the days and nights packed with hard work . . . our college training . . . the numberless flights with patient instructors . . . the painstaking way we were taught to fly safely on instruments, how,

flying wing tip to wing tip, we were brought together closer than brothers . . . I understand what our General means. The Army Air Forces are more than planes, more than men, more than machines—a *great team* with one aim, one object, one goal.

"... to sweep the skies clear, so free men may walk with their heads up and without fear..."

And as the last man receives his wings and the gun booms out and we stand retreat and the flag comes slowly down, I'll thank God *my* father and mother gave me the chance to win my wings . . . belong to the greatest group who ever fought or flew . . . gave me a future and a career!

"And now, gentlemen, we have work to do—and I leave you . . . good luck—and good hunting!"



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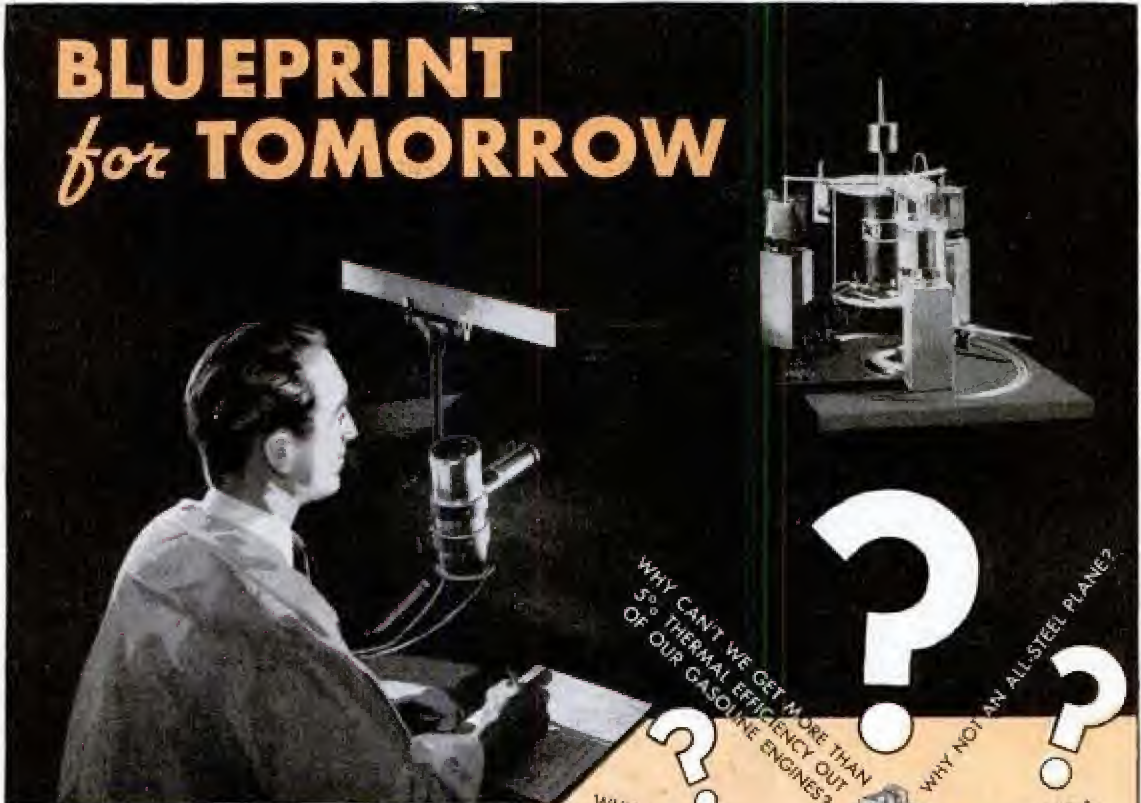
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Vol. 81

JANUARY, 1944

No. 1

BLUEPRINT for TOMORROW



By Charles F. Kettering

Vice-President, General Motors Corp.
Chairman, National Inventors' Council

Washington, D.C.

SOMEBODY has said there are more than 300 postwar planning groups in the country. Well, that isn't enough. There ought to be 130,000,000 postwar planning groups. Every man ought to be his own.

We have a simple test to distinguish between postwar planning and postwar wishing. If the plan presupposes that human nature is going to be different after the war, it is pure wishing—and should be thrown out.

On this basis, very little real postwar planning is being done. When you take the wishing out of most postwar planning, there isn't very much left. If

To succeed, an inventor must learn how to fail intelligently, whether he be a physicist in a laboratory, above, or an artisan in his own shop



JANUARY, 1944



Fractionating apparatus at General Motors Research Laboratory

our planning is to mean anything at all, we have to remember that the fundamentals of human nature are going to remain exactly the same after the war as they are now.

The human race has been on earth for at least a million years. Yet it wasn't until about 10,000 years ago that we first learned how to make an "X" mark on the wall of a cave, and we got up to that point from the start without benefit of science, medicine or anything like them. I think that this observation is important because it illustrates the normal time rate of change of human nature. Education, religion, and science accelerate the effects of the change, but they don't necessarily alter the fundamental time rate.

A fundamental part of all biology is continuity. If you plant a pea in your Victory Garden you expect it to come up peas. You don't expect it to

say: "Because there is a war on, I'll change my nature and be a chrysanthemum now."

If you buy a dog, you expect him to act like a dog.

A fellow laid on my desk the other day a study showing that since 640 B.C. the world has been at war about one-third of the time. None of these wars except this last one has affected human nature in the slightest. This last one has changed our thinking a little, but it hasn't changed human nature.

As you know, I am chairman of the National Inventors Council. Out of our experiences has come a notion that we can educate people to be inventors. The way to do it is to teach people how to fail intelligently. That is all you have to do to be an inventor.

We have made two or three surveys that show that the more education a man has, the less likely he is to invent. It should be exactly the other way, but we think we know why it isn't.

The average person, from the time he is six years old until he is graduated from college, is examined three or four times a year—and if he flunks once, he is disgraced throughout his community.

These are some of the automotive developments of Mr. Kettering and General Motors



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expect too much of us. A research man is just a professional amateur. He is an amateur in that he is doing a thing for the first time—and he is going to do it just as poorly as anybody ever did anything for the first time.

Research is a straight case of cut and try—and I think we have oversold it as being something that can pull things out of a hat. We've somehow fostered the idea that science is conquering nature. That isn't true. When a scientist conquers something, he bends his knee and does exactly what nature asks him to do. He has learned that conquering is submission. You can't get nature to do anything it wouldn't do ordinarily, no matter how noted a scientist you may be.

We think we've learned an awful lot about navigation. But a bat can fly perfectly around all sorts of obstructions with a blindfold over his eyes. When that phenomenon was investigated, it was finally discovered that if the bat's ears were plugged, he couldn't fly so very well—and if his mouth were taped shut he couldn't fly at all.

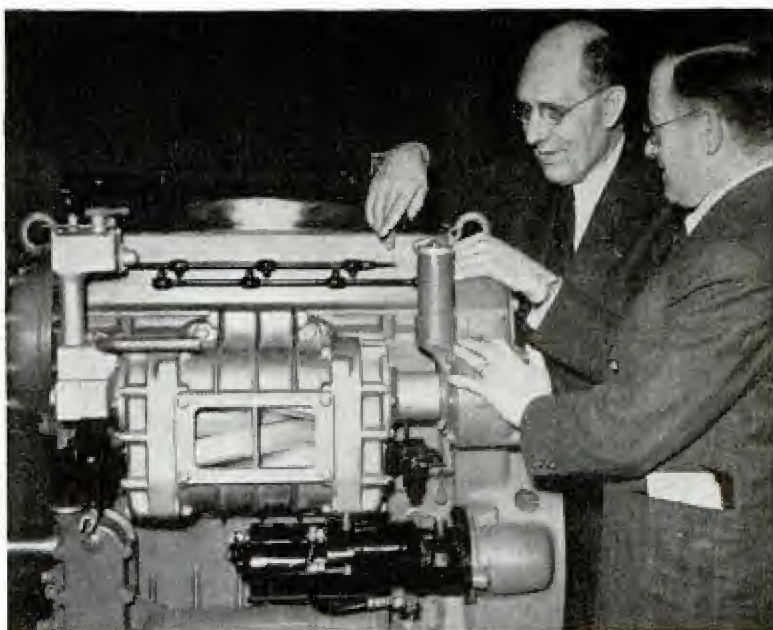
It was found that the bat navigates by supersonics. He gives out a high frequency wave and it echoes back, and he turns his

head and gets either a phase balance or an intensity balance. That tells him where an obstruction is, and he doesn't go that way.

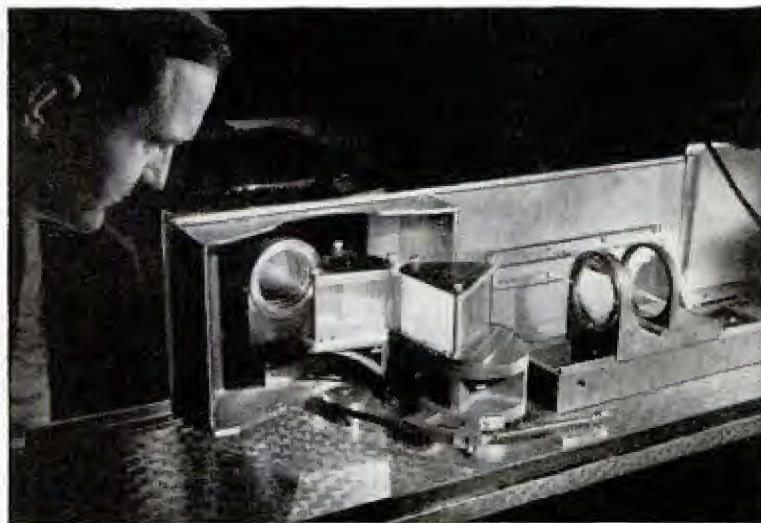
He can put out sound frequencies up to 90,000 cycles per second. Our ears are sensitive only up to about 20,000 cycles per second so, of course, we can't hear the sounds the bat hears. It's only recently that we've even learned how to measure high frequency sound waves of this kind. So it begins to look like we're not so smart after all, because the bat, who is only a dumb animal, has already been using our latest developments for thousands of years.

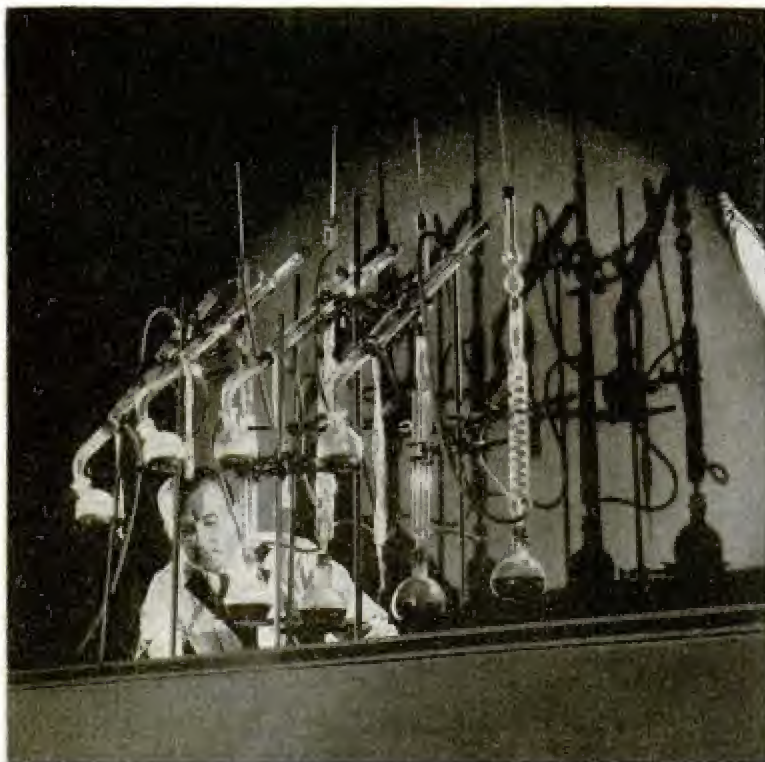
I have hauled pigeons

Spectrograph helps analyze light from burning gases in an engine



Mr. Kettering and R. K. Evans (top) inspect General Motors lightweight Diesel. Below, bat uses "supersonic echo" to avoid obstacles in darkness





Chemical apparatus used in polymerization, the changing of the molecular structure of hydrocarbon fuels to forms of more desirable antiknock value

to Detroit many times, collected from Dayton, Xenia and Springfield. They had no gyros, no speed indicators, or anything else, but they flew back home all right. Again, they were dumb animals! We're surely smarter than they are, but I'd hate to trust myself to a pilot who had as few navigating aids as a homing pigeon.

Take the geese and ducks which come to

Postwar farm vehicle might be tractor with removable treads, convertible into a light car, Kettering hints



Michigan. They get here within a day or so of the same day every year—without the help of any weather department. If there is a north wind, they will be a day late; if a south wind, they will be a day early, if no wind they will be on time.

I have always had a rule for myself: Never fly when the birds don't, because they have a lot of experience.

I have pointed out these things about dumb animals because I sometimes think we get ourselves so completely detached with slide rules and things of that kind that we begin to believe that is where engineering began. But it didn't. Engineering has been going along pretty well for a long, long time.

The automobile industry is fundamentally a power industry. Our job is to get more horsepower for less fuel. The fundamental efficiencies of the units we work with are an untouched thing.

In the automobile industry we are getting only about 5 percent thermal efficiency out of the cars we drive around. We have 95 percent left to work on. Some people will pull out a slide rule and tell you we can't improve that ratio a bit. I don't believe that for a minute.

I told a friend the other day that, after the war, I think we will produce a Diesel

71645

engine with 50 percent thermal efficiency. Right away, out came the slide rule, and he said: "You can't do it. The second law of thermodynamics is against you."

I said: "I don't know what that is. The only thing I know about the second law of thermodynamics is that you can't push on something that is going faster than you are."

I think you can calculate to find the framework in which you are going to work, but then you have to work the problem out specifically. One of the difficulties in all our technological education is that we try to set down formulas for calculating specific devices before we understand the basic principles.

I was talking, the other day, to a fellow from one of the big steel companies. He said he didn't know what was going to happen to the steel business, what with the increased facilities for producing aluminum and magnesium and plastics and all that sort of thing.

"Why does that worry you?" I asked him.

"There is a lot of research going on," he said, "in all these other materials."

"Why isn't there a lot of research going on in the steel business?" I asked.

"There isn't much more you can do with steel," he said.

Well, I can't understand that. We want stainless steel, and we want all sorts of new kinds of steels. A friend asked me what we are doing in development of aluminum automobiles. I said:

"We aren't doing anything. And just to start an argument, I will bet you even money that we will have a steel airplane as soon as we will have an aluminum automobile."

He was shocked. He said:

"You can make a thing a lot lighter out of aluminum than steel. Steel weighs three times as much as aluminum."

"I know that," I said, "but steel is five times as strong."

Too often, we get stamped into thinking that some of our rules of thumb are absolute laws of nature. It is the airplane that is important and it should be made from the materials best suited to it regardless of what they are.

(Continued to page 160)

JANUARY, 1944

Land Torpedo Invented by Nazis Defends Posts Along Coasts



Firing torpedo from so-called German fortress along the coast

Using torpedoes as a land weapon is a military innovation claimed by the Germans. Nazi experts say the torpedo, hitherto used only as an underwater or aerial weapon, can be used to greater advantage as a land weapon. Tubes for firing torpedoes have been installed at special fortified points along European coasts, according to reports. They are manned by torpedo experts and artillerymen.

7828

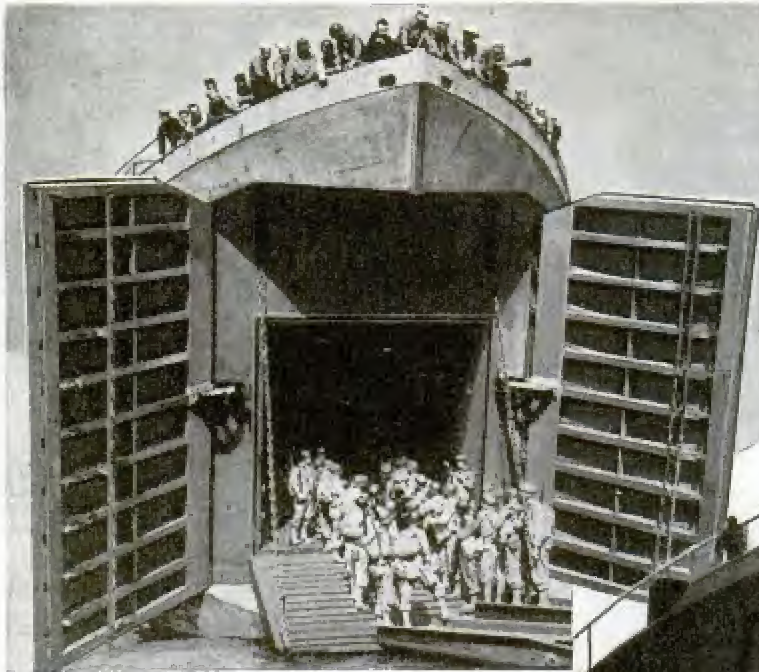
Soft Woods Converted to Hard "Plastic" That Will Neither Warp Nor Swell

Sticking drawers, doors or windows made of wood may be a thing of the past with a new impregnating treatment that makes soft woods as hard as plastic. The treated wood will not warp or swell and is so hard that it may be substituted for steel in certain textile machinery parts. The process, developed by E. I. du Pont de Nemours & Company, consists of impregnating the wood with resin-forming chemicals that react with the wood cellulose to change the properties of the wood. In the past, resin solutions, such as lacquer, were used to fill the wood cells but the properties of the wood were not fundamentally altered.

¶The pupil of the human eye can expand to about 60 times its fully contracted area.

S. J. F. T. Berkner
Gamma Dept.
Wilmington, Del.

Landing Ship Unloaded Through Hinged Nose



When an American tank landing ship reaches an invasion shore, it disgorges its load of men and equipment through hinged doors which form the prow. Left, showing the doors open, and ramp down to form gangway. Below, how the bow doors look closed for voyage



Yankee troops by the thousands knew that the nose of the LST (landing ship, tank) held a secret before the Navy made the fact public. For this type of craft was used from the beginning of the American invasions to put armed, ready-to-fight Yanks and their equipment ashore. Afloat, the LST's nose trimly cleaves the water, giving scant hint of its double life. But once the craft has pushed up onto a hostile beach the nose sections swing wide—they are in reality two huge, hinged doors. When they are open a ramp inside is lowered. And over this ramp streams the complement of men and weapons.

Larger Screen for Television Designed for Postwar Sets



Image is projected through lens to mirror on underside of lid

Postwar television sets may be equipped with an enlarged translucent screen $13\frac{1}{2}$ by 18 inches. The image is projected through a lens to a mirror on the underside of the television cabinet's uptilted lid. It is reflected from the mirror to the viewing screen. The new screen, developed by RCA laboratories, is expected to further the popularity of television, for the scope of television subjects in the past has been somewhat limited by the size of the projected picture.

¶The retina of the human eye is about 3,000 times as sensitive as the fastest photographic film.

Merrill, Chapman & Scott
N.Y.C.

71 849

Salvaged Normandie Floats Again on Even Keel

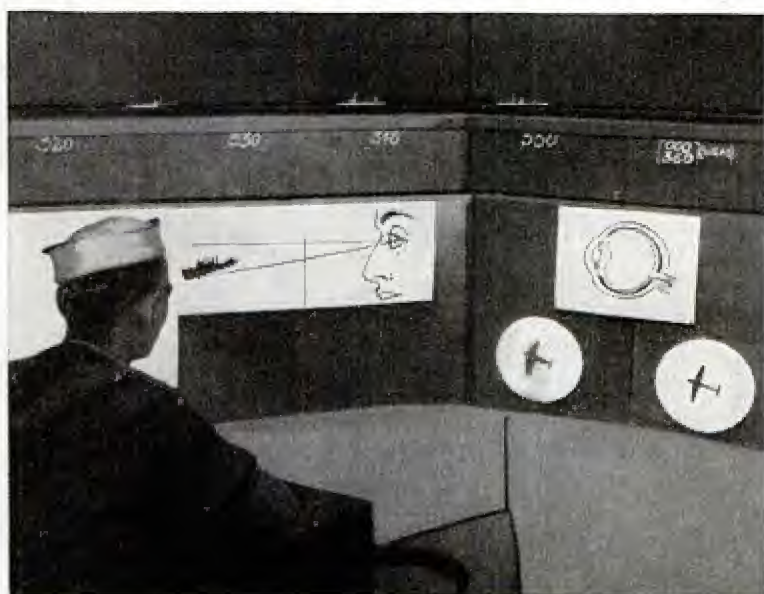
Floating again on even keel, after one of the most complex salvage operations in history, the former luxury liner Normandie has been towed from Pier No. 88 in New York harbor to a naval base for refitting. The 54,000-ton ship, which was renamed the U.S.S. Lafayette, burned and capsized Feb. 9, 1942. It took 20 months and four and a half million dollars to raise the ship which may still see service as a troop transport before the war ends. The salvage work was carried on while the ship pivoted on a rock shelf, and at one time it was feared the hull might crack in two. Careful balance was maintained during operations which included removing 29,000 tons of superstructure and hundreds of tons of mud and water.

The U.S.S. Lafayette, better known as the Normandie, may see service before war ends



71 644

Night Lookout School for Sailors Helps Spot Ships in Dark



Officers and men who man America's new destroyer escorts are trained to recognize all types of ships, gunfire, and lights at a special night lookout school on the East Coast. On a dim and realistic horizon in the lookout room, they watch ship models that have only a dim light behind them. If the student recognizes a battleship he sings out the type of ship and position: "Battleship two points off the starboard bow." The men wear glasses with red lenses during a lecture that precedes the test, so that when the lights are turned out they will be accustomed to the dark.

On walls of lecture room models appear as they would in semi-darkness

JANUARY, 1944

Destroyer Escort School
U.S. Navy
Norfolk, Va.

Thos. G. Hinman
3872 Franklin Ave., Los Angeles, 27, Calif.

77621

WINDJAMMERS of the SKY



of the air and free ballooning is a sport unlike any other in the world. But Navy Balloon No. 03546 was not on a pleasure cruise this trip. Lt. Steelman's crew consisted of naval aviation cadets who were learning to pilot the Navy's big anti-submarine patrol blimps. Free ballooning is the basis of their education. Their ability to maneuver the two-engined blimps depends on how well they learn their lessons in lighter-than-air. In case of engine failure they could use their knowledge to handle a blimp exactly like a free balloon.

You might suppose that a balloon is at the mercy

Basket of free balloon at Moffett Field gets change of crew. Below, instrument box for navigation boasts altimeter, clock

SOME mysterious force in the atmosphere had taken charge of the big free balloon and was treating it like a child's rubber ball.

The student pilot in the wicker basket below the bag was worried. He had been ordered to take it up to the 500-foot level but every time he rose to 150 feet something batted the balloon earthward again. It rose and fell as if it were bumping along in slow motion under a solid roof.

Lt. George N. Steelman, free balloon officer in charge, grinned and explained the trouble. He told his student crew "There's a stratum of air of different temperature overhead that won't let us through. Spill out two handfuls of sand and see if that helps."

It did. The few ounces of ballast that were tossed over the side lightened the balloon enough for it to ascend steadily through the layer of air. At 500 feet the craft encountered a northwest breeze and began to drift along toward San Jose.

Free balloons are the sailing vessels





Pressure of the hydrogen gas within distends the balloon into a perfect sphere. Right, inspecting "appendix" left open in flight

of the winds. But at such lighter-than-air bases as Moffett Field in California the aviation cadets learn that this isn't necessarily so. They learn that within reason they can maneuver a balloon to travel in any desired direction and that not infrequently they can bring it back to land at the spot from which it took off.

By now Steelman's balloon was over San Jose and he wanted to change his course to the west. He started fishing for a wind. Over the side he dropped small pieces of tissue paper and watched them as they streamed one after another toward the ground. Halfway down they veered toward the east. There was a wind down there



*Y. A. R. Brown, 12th Naval District
Public Relations*



Down for lunch, balloon crew "walks" basket along highway

but it was going in the wrong direction.

"Out two handfuls," he ordered.

Two handfuls of sand went over the side. There was no sensation yet the bubble on the statoscope instrument that shows changes in barometric pressure indicated that the balloon was rising. At 1,000 feet the balloon's shadow on the ground started to move toward the west. Steelman had the wind he wanted.

"Valve one second," he directed. A cadet pulled on a line, opening the valve at the top of the bag long enough for one second of hydrogen to escape. That leveled the balloon off

Hydrogen storage flasks are anchored in concrete holder



at the new altitude. Free ballooning seems like a quiet, peaceful sport and yet there are a hundred and one tricks that Steelman must teach his students. Every bit of knowledge that he can impart from his 2,000 hours of experience in flying and racing the big bags will aid them in their careers.

A free balloon moves with the wind, so except for an occasional flurry when the wind changes direction, the bag seems to remain in a dead calm. And there is no sound from its flight. The creak of the cordage, the patter of the carrier pigeons' feet in their wooden box, and noises that rise from the ground are all you hear.

Still, free balloon enthusiasts have a few wild tales they can tell, such as the time when Lt. Steelman found himself at the mercy of a whirlwind. His balloon began to spin around as if it were attached to the periphery of a merry-go-round. The basket and drag rope were streaming out almost horizontally. Gas spilled from the open appendix so rapidly that the balloon was sinking in spite of all the ballast that was released. The wild ride ended safely close to the ground where the cyclonic force of the wind was weaker.

The most thrilling adventures of all were back in the days of the international balloon races. These races were for the greatest possible distance and so the two-man crews let wind and temperature

take charge, hesitating to valve out even a second's precious gas at any time. In spite of the fact that they knew they would encounter sub-zero temperatures at high altitudes they usually were nothing but shorts, to save weight.

Steelman and Capt. T. G. W. Settle starved themselves down almost to skin and bones for the 1928 race and refused to carry an oxygen supply because of the weight of the containers. They were carried up to 18,000 feet and then a thunderstorm took charge, lifting them up to 21,000 feet and then dropping them down again at so great a speed that they passed bags of sand that they had tossed out a moment earlier to prevent just such a descent.

The Navy's training balloons are of 35,000 cubic feet capacity and are inflated with hydrogen because of its great lifting power. A pilot, first and second sandmen, log keeper, and valveman make up a crew. Thirty-one bags of sand, weighing 30 pounds each, are carried as ballast, permitting several flights to be made during a day so that several crews may receive training. The balloon's basket is also fitted with the statuscope instrument, a clock, and a 225-foot-long drag rope. At low altitudes over hilly country the drag rope can be used as automatic ballast, for the balloon is relieved of the weight of as much rope as is allowed to drag on the ground. Thus a pilot who is dragging part of his drag rope over the ground can climb when he encounters a hill by paying out more rope, hence lightening the balloon, and if he wishes to descend the other side of the



Spilling sand ballast over the side to speed ascent of balloon. Below, landing in field as blimp watches





Ground crew "walking" balloon out of hangar. Pulling on rip cord (below) to collapse the balloon after landing



hill he retrieves enough rope to cause the balloon to settle.

Aviation cadets average seven instruction rides each plus at least one ride in which they are in complete charge. Each must be able to land his bag gently, a trick that isn't as easy as it looks and that is accomplished by valving enough gas to cause the balloon to drop, and then judiciously dropping sufficient ballast to ease the fall and finally bringing the balloon almost to equilibrium as it approaches the ground.

Learning how to ascend through a temperature inversion is easy but learning how to descend through the same kind of freak condition and to do it safely is more difficult. After a balloon has been forced up through cold air into a layer of warm air it is just as reluctant to descend again as it was to make its initial climb.

The only way to get down is to valve enough gas to cause the balloon to fall through. That is easy, then the pilot must immediately estimate the amount of ballast that he must jettison to check the elevator-like descent and prevent a crash landing.

A free balloon is the most sensitive vehicle in which man ever rode. Not only does it react to the slightest change

The cadets who graduate from Steelman's lighter-than-air cruises have a certain confidence that they didn't possess before. "Any one can fly an engine," they remark, "but you need horse sense to be able to fly a free balloon."

Experts of the Department of Agriculture in Washington are seeking someone with a peculiar talent. They want information on how you can skin the kernels of black walnuts, hickories and pecans quickly and completely. Ground fine, these nuts make butters that help piece out our wartime dairy supply. They particularly want to get rid of little spots of skin adhering to the kernel, as these detract from the esthetic attractiveness of the butter, though not from its taste.

One of the "secret weapons" that helped push the Germans out of North Africa and Sicily was a portable pipeline that supplied advancing units with fuel or water. The pipe, developed by the Shell Oil Company, is lightweight and flexible. One man can handle a 20-foot section. The steel is so flexible it can be bent around trees, and can be laid at the rate of 10 to 30 miles a day. Pumping stations are located at intervals of about 20 miles. It is made in four- and six-inch diameters, the latter having a capacity of 25,000 gallons daily. One of the desert pipelines in Africa was more than 300 miles long.

Troops at a British school of military engineering have devised various expedients for transporting their heavy military equipment across rivers and lakes. In one instance, a Bren gun carrier made the water crossing supported by kapok floats. The rotating tracks of the gun carrier were used for steering.



Kapok pads keep Bren gun carrier afloat, while tracks are used to steer

Public Historical Service
410 N. Michigan Ave.
Chicago, Ill.

71468

The WEB-FOOTED ENGINEERS

Major Julian Leggett
2200 7th St. N.E. Wash. D.C.
Ordered Dayton, Ohio



Modern-day shock troops must build, as well as fight. It is not enough to effect a landing on the beaches or river banks held by the enemy—the way must also be paved for the troops that are to follow. Infantry above have “forced” river crossing, and leap with fixed bayonets out of their boats to establish bridgehead

Assault boats used by the engineers lead a versatile existence. Above, a platform is laid across a pair of them to form a light ferry capable of carrying peep. The impromptu ferryboat is paddled across the river

Signal Corps photos



Oceans are no more obstacles than are rivers. Truck above is driven to beach from barge that ferried it ashore from ship at anchor



It's in the traditional engineering job of bridging enemy streams that this web-footed unit shines, left. A “bridge of boats” supports treadways laid across a stream where bridgehead has already been secured. Heavy equipment may use this span

Amphibian Command men, right, rush ashore with markers, to indicate the spread of their installations, as a guide to gunners on Navy craft laying down protective barrage from offshore. Markers also help to guide later landings



Below: Markers in place, the men speedily lay down a wire roadway which keeps vehicles from sinking into the sand



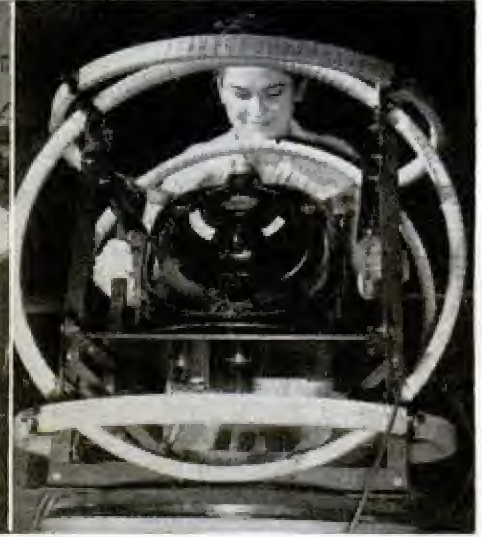
Now the roadway is laid, and the commanding officer's jeep (right) is driven ashore, so that he may personally supervise progress of the operations



Roadways of the type in picture below can be laid almost as rapidly as the wire can be unreeled. Mechanized equipment rolls up it into action



First "True" Compass Guides Fliers to Target



Compass transmitter is shown on the tail of the plane (top left) with master dial on the nose, amplifier in center. Above, testing new compass; left, "fins" used on the compass



cording to W. A. Reichel, director of engineering for the Bendix company. The needle will not lag or overshoot during a turn, nor does it "hunt" back and forth in rough weather. It functions perfectly within 300 miles of either pole, regions where magnetic compasses are useless. This factor is expected to play an important part in postwar aviation along arctic routes. Because the transmitter of the compass can be located at a distance from the indicating dial, it can be installed on a plane where it will not be affected by metal parts, such as armor plate, that impair the accuracy of the standard compass. As many compass dials as are needed for the crew can be mounted in a bomber. Development of the compass was made public only after one of the instruments fell into enemy hands. Bendix officials believe it will be impossible for the enemy to duplicate the performance of the compass during this war.

Hailed as the greatest advancement in its field in 4,500 years, the Gyro Flux Gate compass is guiding U. S. bombers to remote enemy targets and home again. The new compass, developed by the Bendix Aviation Corporation, requires no "correction card" which is necessary with magnetic types because it gives the "true" reading. This eliminates the danger of error by pilot or navigator in the heat of combat. The flux gate compass uses the earth's magnetic field to develop minute electrical impulses which, when amplified, turn the compass indicator. The impulses are taken in through the "flux gate" which receives and rejects the magnetic flux from the earth. The flux gate is a triangular-shaped coil attached to the bottom of a gyroscope which keeps the unit on a horizontal plane. This compass will not go off its reading when a plane dives or climbs rapidly, ac-

Land Torpedo Guided by Cable Is Nazi Antitank Weapon

Nazis in Russia have introduced an anti-tank land torpedo, resembling a small tank and about the size of a motorcycle sidecar, operated by remote control. The torpedo carries about 150 pounds of explosive in its nose, and at the rear has a reel of cable that leads back to an operator, in a shelter up to 1,500 yards away. By means of electricity, the operator guides the machine and sets off the explosive. The best Russian defense has been to cut the cable.

Carl (Bayer & Associates)
10 C 40 St.
N.Y.C. 16

Whitaker

Steel Airfield Mats Become "Armored Road"

Tests of the practicality of steel highways are under way near Darien, Conn. Steel grating, similar to the landing mats laid down for combat airfields, was installed in a stretch 48 feet long and 22 feet wide, in the first practical test of "steel armoring" under normal passenger and truck traffic use. The technique calls for attaching steel grating panels, each 2 feet by 12½ feet, filling the mesh with ordinary construction sand, then applying a coating of road oil. Spokesmen of the Irving Subway Grating Co., manufacturers of the steel-type roadway, foresee its use especially in a network of secondary roads, and particularly in districts where weather conditions



Landing-mat type of steel grating is laid for test roadway and graveled

result in frequent washouts and other impairments of normal road conditions.

Pre-Pasted Cedar Wallpaper Transforms Clothes Closet

Ordinary clothes closets are changed to cedar closets with a ready-pasted wallpaper that retains the cedar odor. The paper is made from cedar wood which the

finished product resembles with variegated grain and realistic knots. No special tools are required to hang the paper; it is merely dipped in a tub of water to wet the adhesive on the back and then pressed against the wall. The paper comes machine-trimmed. It can also be used for lining chests and bureau drawers.



Dipping cedar wallpaper in tub of water wets the adhesive on the back and it is ready for hanging on closet wall (left). No special tools are needed



Eye and Nose Beat Machines Spotting Bad Eggs

Many a mechanical marvel has been devised with more sensitiveness than its human inventor, but science has yet to evolve anything better than the human eye and nose for detecting bad eggs. The problem is a vital one in an egg-drying plant. No one has yet endowed a mechanical egg breaker with the ability to smell out and discard bad eggs. Experts still do the job by keen sense of smell and observation.

F. L. Oliver, Captain U. S. Navy (Ret.)
401 5th St. East Office Bldg.
Pittsburgh, Pa.

71647

HOW JAPAN WILL BE DEFEATED



U. S. Navy photos

A Navy dive bomber comes home safe from a Pacific raid. Below, a destroyer claims two Jap ships and five planes downed in combat

By Frederick L. Oliver

Captain, U. S. Navy (Retired)



JAPAN did not make the momentous decision to strike simultaneously against the world's two greatest naval powers in the belief that its outnumbered force of battle-ships, cruisers, and destroyers could prevail against the battle line its enemies could muster.

We now know the Japanese based their hope of quick victory on airpower projected from carriers and island air bases. They were so confident of success that, misled by early triumphs, they were foolish enough to visualize Hawaii, Alaska, and the west coast of the United States as ripe plums practically within their grasp, and even indulged in the bombastic prophecy of peace terms being dictated by them in the White House.

By astute dissemination of misleading information and rumors over a period of years,



Bluejackets pass the ammunition to feed a 40-millimeter Bofors antiaircraft gun aboard an aircraft carrier

Japan had concealed the extent to which it had developed its airpower, and succeeded in creating the impression that great difficulty was experienced in obtaining well qualified pilots, in particular pilots who could successfully operate from carriers.

As a result of clever propaganda and the security of information afforded by racial characteristics and language difficulties, Japan was able to enter the war with a much greater carrier and air strength than

had been considered possible. It does seem that we were remiss in not having reached a more considered estimate of what to expect from Japan's repeated attempts to bring about the outlawing of airplane carriers, the secrecy with which its naval building program was shrouded, and its spy complex.

In launching the unexpected attack on Pearl Harbor, the Japanese gambled on delivering a blow that would practically im-



PT boats sweep the seas with guns, torpedoes, depth charges



Old Glory still flies above the Hornet after a Jap dive bomber has crashed into signal bridge during the battle of Santa Cruz Islands. Below, one of the fast-growing fleet of escort carriers

mobilize the United States Navy, and they succeeded to an extent probably beyond the expectations of the most air-minded Japanese admiral. Fortunately they did not follow up the advantage with a thrust in force to seize the Hawaiian Islands. Why they passed up their golden opportunity will not be known until Tokyo's archives can be scrutinized.

The prewar Pacific Ocean naval campaign plans of the United States should have and unquestionably did provide for all likely contingencies, but the possibility of incurring what amounted to an immobilization of our force of battleships without a corresponding or greater loss being inflicted on Japan probably was given little thought, and it is to the eternal credit of our Navy that it promptly put into effect plans which utilized its remaining strength to good advantage. Relief of the Philippines, Guam and Wake was out of the question, but a succession of spectacular effective raids on widely separated Japanese outposts not only resulted in sinking several enemy carriers, but left Japan to speculate where the next blow would fall, and prevented a total



mobilization of its naval forces for the operations that struck at Midway and the Aleutians.

Japanese airpower successfully paced the campaigns which overran the Philippines, Singapore, Burma, and the Netherlands East Indies and portions of Melanesia. In these areas the Allies did not have sufficient air strength to counter the pent-up flood of planes so unexpectedly loosed by Japan, and making additional planes available was contingent on transportation facilities as well as the diversion of effort between the two main theaters of war in accordance with the overall strategy adopted. This strategy gave top priority in planes to the European area, and in the Pacific we had to operate against Japan with such resources as could be made available.

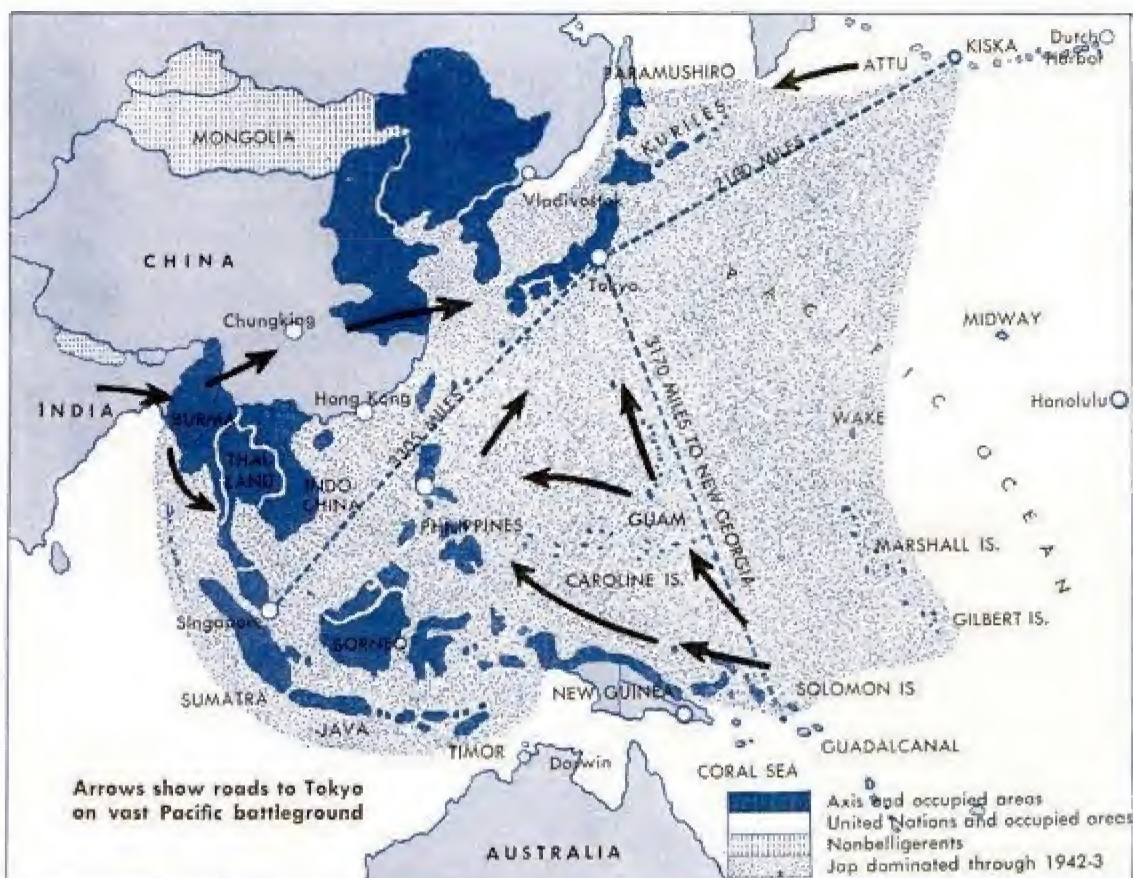
It was immediately apparent that Japanese designs on Australia must be frustrated at all costs, and that our long line of communication over which supplies flowed



Gunner of Navy fighter plane gives his weapon a last swing before takeoff

to the South Pacific must be made safe.

Japan had lost no time in advancing the island bastions which form the outer defenses of its homeland. Strategic Rabaul in New Britain was an early conquest, and the project was afoot to overrun all of New Guinea to provide bases from which the invasion of Australia could be projected. In addition, an ambitious island by island advance through the Solomon Group was





Pushing a Grumman "Wildcat" from carrier's elevator to takeoff position

undertaken with the ultimate objective of gathering in the New Hebrides, New Caledonia, the Fiji group and probably Samoa, thereby placing the Japanese astride the long Allied supply line from Honolulu.

These projects were nipped in the bud by the last ditch stand in Southeastern New Guinea which developed into a valiant Allied push that has all but eliminated the

Japanese as a factor in New Guinea, and the now historic campaign that ejected the Nipponese from Guadalcanal.

Our attack on Guadalcanal was exquisitely timed when the airfield under construction by the Japanese was within a few days of completion. Due to unforeseen difficulties, reinforcements and supplies were slow in arriving, but American grit prevailed over Japanese fanaticism, and the previously invincible Nipponese warrior had his ego deflated. How far the virus of defeat will percolate among the Japanese remains to be seen, but no nation can experience such a one-sided and devastating trouncing by land, sea, and air as the Japanese underwent in Guadalcanal and the subsequent actions in the Solomons without loss of morale.

In particular was demonstrated the weakness of Japanese aviation—the arm to which Japan had looked for reaping an early victory. Not only were Japanese planes tumbled out of the skies at a ratio at times of as high as 25 or more for every United States plane, but their loss of planes reached such a staggering total that Japanese air strategy must be in course of revision.

Japan is becoming more and more unable

At one of the South Pacific island stepping stones to Tokyo a crane helps a truck ashore from a supply barge



to cope with the growing United States sea and air power in the Western Pacific and the Aleutians. Its losses of planes and ships, both naval and commercial, have been in excess of replacements, whereas Allied strength in all categories increases daily.

The strategy open to us in the Pacific hinges to a certain extent on the progress of the war in Europe, but it is interesting to examine the various possibilities.

Japan is an island empire. It is as much dependent on sea-borne transportation as Great Britain, and its lines of communications must be afforded protection by its navy and air strength. How much remains of the Japanese Navy and air force we do not know, because there are no reliable statistics of Japan's pre-war strength, its losses, and replacements. However, there is good reason to believe that both of these arms are greatly reduced in strength, and in addition it is evident that the present crop of Japanese fliers is distinctly inferior in skill, training, and technique to the carefully trained aviators who manned the vast number of planes Japan has lost since Pearl Harbor. The Japanese fleet has become increasingly reluctant to offer battle, and well it may, because all that stands between Japan and defeat is the remains of a once formidable fleet. Consequently the primary strategy of the Allies in the Pacific is to destroy the Japanese fleet either piecemeal or in a major engagement.

Whatever strategy is adopted in the Western Pacific will have the ultimate objective of striking at the Japanese Islands,



From the Flight Control post on one of our newest carriers the Flight Operations Director watches a Douglas "Dauntless" dive bomber get away



Torpedomen watch from the turret above a destroyer's quadruple tubes. Below, flame and metal spew from 40-millimeter Bofors antiaircraft guns—rapidfire automatics that have an impressive record against Jap planes

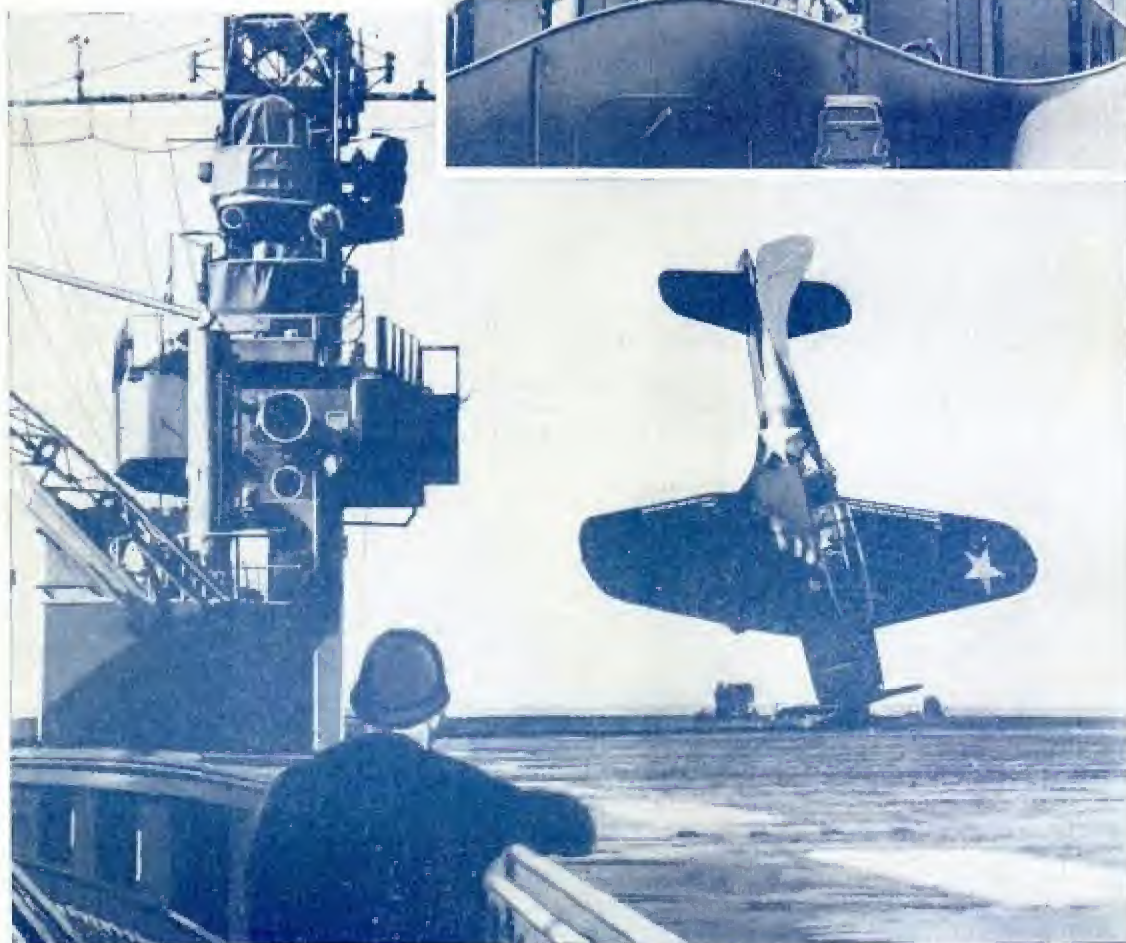
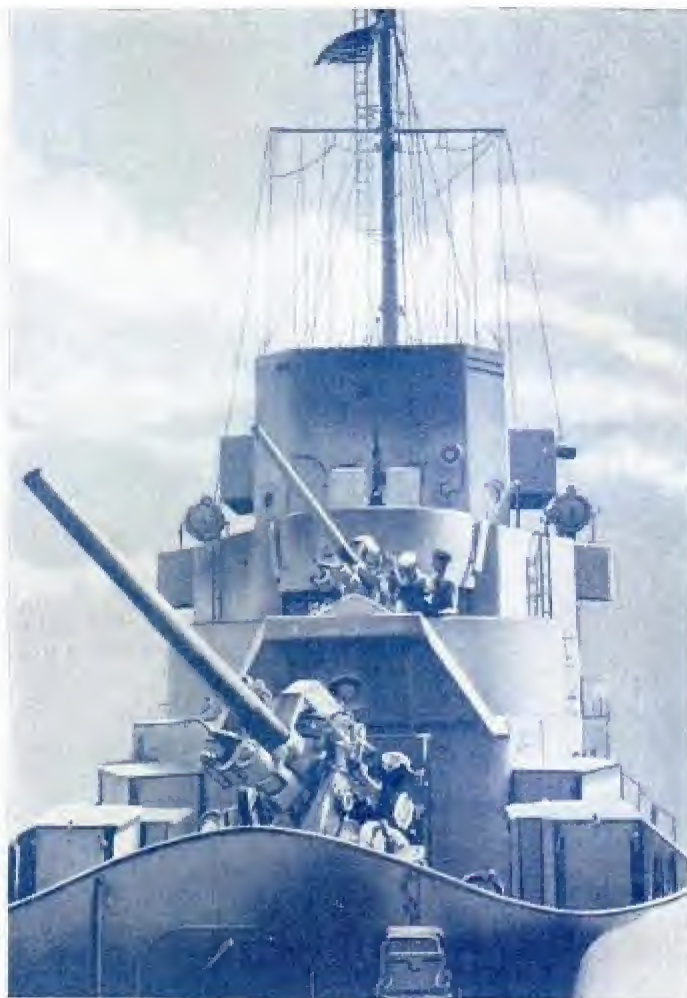


because there lies the core of Japanese resistance, and in order to dissipate the Japanese menace for all time it is necessary that the myth of their homeland being inviolate be dispelled.

The following courses of action in the Pacific are open to the Allies either singly or in various combinations:

1. Attack Japan via China.
2. Attack Japan from the Aleutians, possibly making use of Siberian bases.
3. Isolate and take strategically located Japanese bases in the Mandated Islands, and eventually retake the Philippines to provide bases from which Japan's vital lines of Communication can be severed.
4. Wage a war of attrition on

Bristling with 3-inch guns, 20-mm. Oerlikon antiaircraft guns and depth charges, destroyer escorts (right) are deadly against subs. Below, pilot and gunner were unhurt when this "Dauntless" nosed over on the carrier's deck





Japanese naval and merchant vessels.

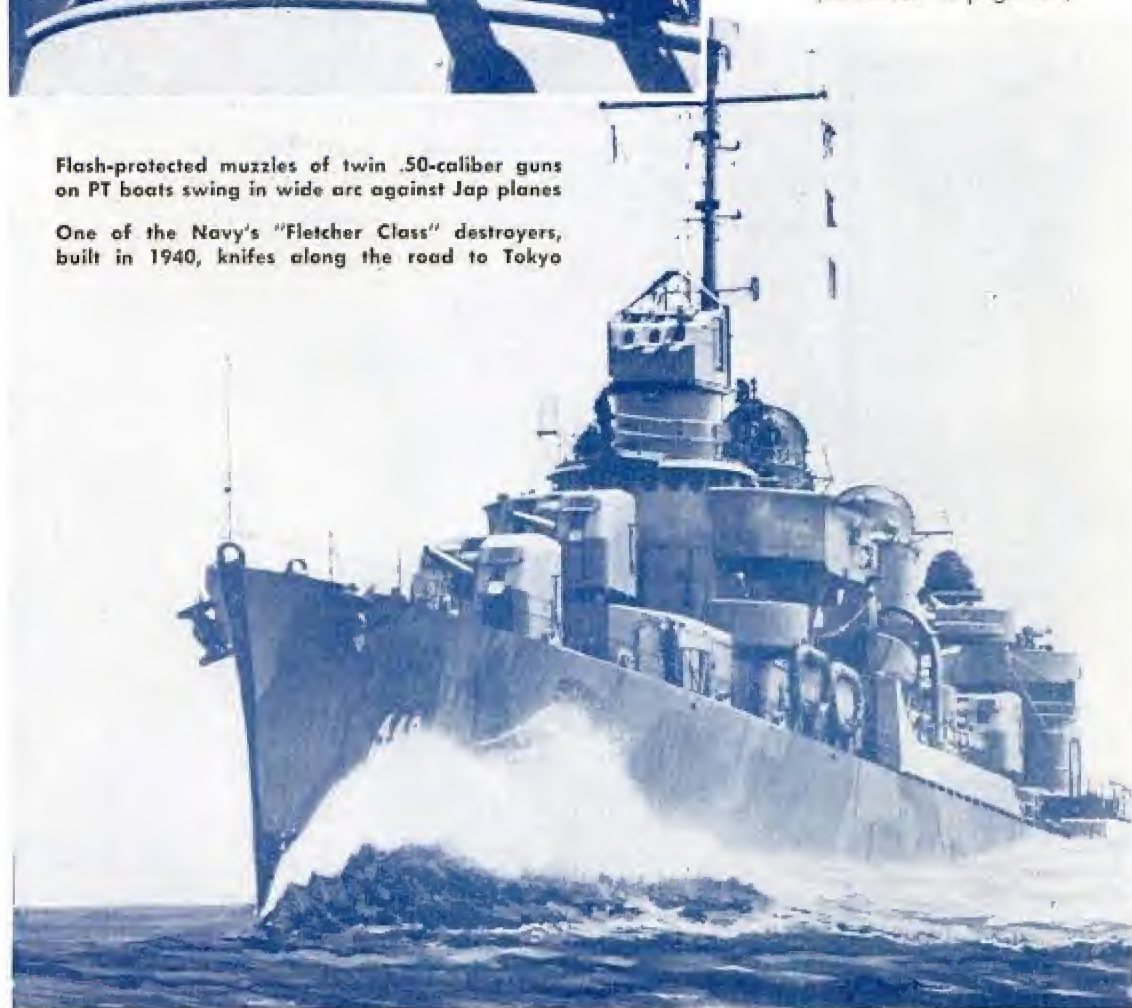
5. Make a direct attack on the Japanese Archipelago.

Examining these procedures in order, we find the route into China is long and tortuous except by sea, and there the Japanese Navy stands in the way. The project of reopening the Burma Road seems definitely set for the near future, but let there be no delusion about the capacity of this route. In good repair and under expert supervision it cannot handle sufficient supplies to support a major campaign. The most that can be expected from the Burma Road is transportation of enough gasoline to maintain an air force in China strong enough to prevent Japanese planes from operating in that area, fly nuisance bombers over Southern Japan, and provide

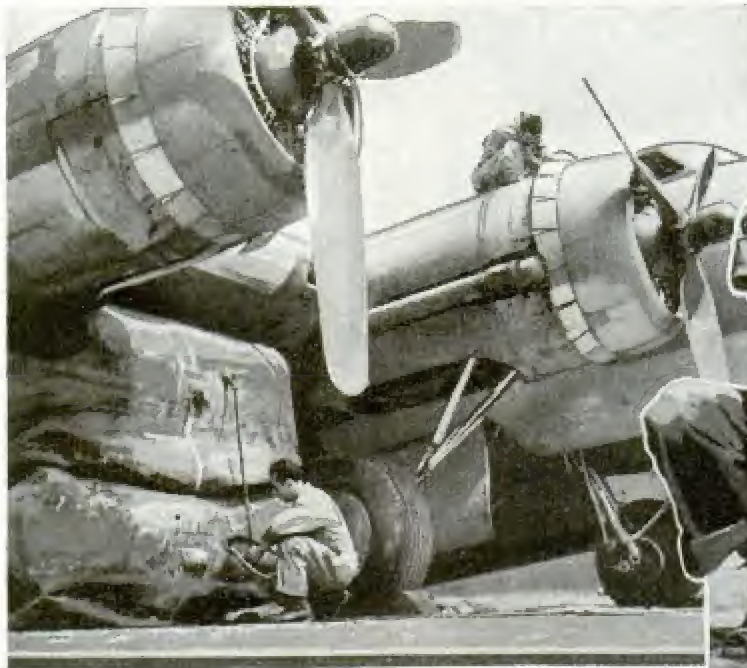
(Continued to page 156)

Flash-protected muzzles of twin .50-caliber guns on PT boats swing in wide arc against Jap planes

One of the Navy's "Fletcher Class" destroyers, built in 1940, knifes along the road to Tokyo



Lifting Bag and Poppet Riveter Repair "Forts"



By "reverse lend-lease," British furnish these tools to repair a Yankee bomber. Left, inflatable bags used to jack up wings. Below, a "poppet" type of riveter



Flying Fortresses based in Britain are kept in fighting shape, in part, with tools supplied in Britain by a variety of "reverse lend-lease." One such implement is a poppet riveter, in appearance of pantograph or

lazy-tongs construction. Another is a lifting bag, or inflatable jack. Deflated bags are placed beneath the wing of the Flying Fortress, then pumped up. Expansion of the bags lifts the wing to facilitate repairs.

71613

Lifeboat Dropped by Parachute Has Motors and Supplies

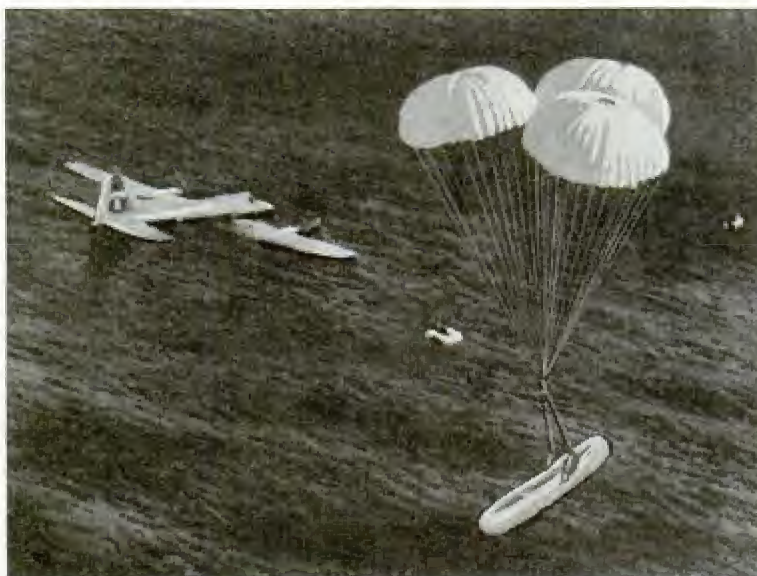
Fliers adrift on rafts at sea are rescued with an airborne lifeboat developed by a British aviator. The boat, which has two motors, is designed for dropping by parachute. It is carried under the fuselage of a rescue plane, and when cut loose drifts

slowly down. The lifeboat has special buoyancy tanks to keep it afloat and prevent capsizing. No matter how it strikes the water, it will right itself. Compartments in the hull contain the motors, clothing, medical supplies, food, flares, gasoline, radio, and sails and oars in case of engine failure.

71546

Modified Vibrator Helps to Start Cold Plane

To provide positive ignition for aircraft engines, regardless of weather conditions, General Electric engineers have designed a starting vibrator. Transformer action within the magneto steps up the low voltage current supplied by the vibrator, providing high-voltage output which assures instant ignition. The vibrator is automatically disconnected from the ignition circuit after starting.



Lifeboat floats down to crew on raft who have abandoned sinking bomber

Mr. C. M. Moore
1362 N. Dearborn
Chicago, Ill.

71674

The LAST MILE IS the HARDEST



HERE'S where the mules take over."—Or they might be camels, or dog teams, or natives, if the trucks can't make it. Or Yankee soldiers with packs on their backs.

The route may be through treacherous tropical undergrowth or knee-deep mud, over mountains, icy trails or blown up roads, across deserts or rivers with logs for bridges. Shells may be bursting, enemy bombers or fighters may be overhead.

Such are the conditions often encountered on the tough, often heart-breaking, last few miles of the route that millions of tons of supplies and munitions travel to the fighting fronts of the world.

Of the thousands of miles these supplies must travel "from producer to consumer," the last lap, from unloading on enemy-held shores or from supply depots to the first line, is by far the most difficult and dangerous, and that in no way discounts the hazards of transportation by ship or plane through submarine-infested waters and bomber-infested areas.

Once munitions, food and other war materiel are landed

Army mules wade reluctantly ashore at a Sicily beachhead to do their part in toting supplies over the mountain trails of the invaded island. Below, loading ammunition aboard an American vessel





A tractor (seen on opposite page) hauls ashore a 105-millimeter howitzer to plaster Japs in South Pacific

or reach supply stations, practically every method of transportation ever used by man is employed. As the Army and Navy Ordnance Departments put it, "when a fighting man in the front lines needs a gun, a tank, a can of soup, or a shoe lace, the armed services must float (ship), fly (plane), roll (truck and train), trot (horse, mule or other beast of burden), or carry it pick-a-back (manpower) from American factories to the battlefield."

In New Guinea and the Aleutians, much

of the task is up to man, dog or mule. In no other way can snow or mud or dense jungle be traversed. Natives are employed whenever possible, and most of them are eager to trade their services for American money or merchandise.

Trucks, tractors and their drivers have done a remarkable job of getting supplies to the front. In the closing days of the battle for Tunisia, when moving ammunition into the front lines was of vital importance, truck drivers remained at their

machines until they collapsed from exhaustion. Eight hundred tons of ammunition were transported every day to one supply point alone. Approximately 1,000 2½-ton trucks were required for this task.

American railroad equipment has done its bit. Lieut. Col. Edward T. Barrett and his crew took an old and wheezy locomotive up a narrow-gauge track in Tunisia to deliver ammunition when the only fuel available was cork. On the return trip, the train was strafed by planes, but the engineer "pulled the throttle wide open downhill" and little harm was done.

Rations for boys at battle front move along a New Guinea trail





and Arctic cold each require a different method of transportation and packaging and storing supplies to protect them against cold, sandstorms, dampness and bombing or attack. Use of natives requires identification of packages by symbols so that the laborer, who understands not one letter of English, can keep straight in his head where the boxes are to be delivered.

Astronomical figures issued by the Army Service Forces show that something more

The airplane, of course, has introduced new ways of transporting supplies as well as men, just as the truck came into its own in the first world war, and as the railroad appeared on the scene as a vital war factor in the Civil War. Huge transports ferry supplies to the front lines, often dropping them by parachute.

The magnitude of the supply job has created new problems in packing, storing, and even marking. Jungle damp, desert heat



Signal Corps photo
Camels driven by natives haul supplies to U. S. Army in India

New Guinea natives in outrigger canoes ply from shore to ship





An "LCM" craft puts ashore a 10-wheel cargo truck on an African beach

than three and one-third million tons a month are being moved to training camps and fighting fronts. Some 700,000 different items, ranging from tanks and big guns to soap and spoons, must be shipped from points of production to use. The Army and Navy must regulate this movement so that at each point of military activity there is a balanced supply of needed items with a large enough cushion of extras to meet emergencies with, at the same time, no oversupply standing idle.

Keeping books on the vast flow of supplies from factories through warehouses and supply stations overseas into the hands of fighting forces is one of the huge, though little-known jobs connected with carrying the war to the enemy.

Under the direction of the Stock Control Division of the Army Service Forces, the flow of this vast tide of equipment is kept

in line through an indexing system operating in the more than 500 stations where supplies are handled. Reports are tied in with those of the 126 major supply installations of the procuring branches of the Army Service Forces, and thus provide a continuous inventory check. As shifts develop in the scope of activity at a depot, or the number of men stationed in the territory it serves, the flow of material can be readjusted at once so that necessary items can be stepped up or an excess flow cut down.

The stock control system, which is similar to the inventory control bookkeeping methods of large corporations, has been designed to operate efficiently at home, abroad or near the battle fronts. Thus, no matter where troops are stationed, a supply depot in that area has on hand a continuously ample stock of needed supplies and munitions. Statistics on the rate of wear and tear and necessary replacement of items of different types, or on the same item in training areas as compared with the field of combat, and elabo-



The "duck," versatile amphibious truck, runs up on a New Caledonia shore with boxes unloaded from ship. Right, a fleet of ubiquitous jeeps makes its daily "special delivery" mail and supply run in New Guinea

Signal Corps photos





Heaps of stuff from back home are unloaded on a wharf in New Caledonia, big U. S. base in the South Pacific

rate studies of the necessary minimum of extra supplies, commensurate with safety in the conduct of the military operation all were utilized in formulating present-day procedures.

Many steps have been taken to effect economies in packing and transporting supplies, especially food. As an example, after Army beef has passed the inspection of the Veterinary Service of the Medical Corps, bones, excess fat and tallow are removed from the carcass as the first phase of the process by which the Army saves 30 percent in wasted weight and bones.

Maintenance of adequate and always-ready service and repair facilities near the front lines is another vital part of keeping battle front supply channels in constant operation. If a truck, loaded with munitions or food, breaks down or gets mired, it

either must be repaired or pulled out immediately, or removed as an obstacle to other trucks, in which case a replacement must be at hand to carry the original load.

A surprisingly large proportion of trucks and other equipment are shipped overseas "knocked down," and are assembled in or near actual war zones. One plant abroad assembled 14,000 vehicles in five months. These assembly depots maintain large stocks of repair parts which are shipped as needed to sub-stations nearer the front from which supplies are dispatched on their last lap to the combat forces.

When the going is toughest, when mud or jungle or enemy fire bogs down even tractors, when an intelligent mule would gallop for cover and a plane couldn't land ammunition even by parachute, the fighting man himself does the transportation job.

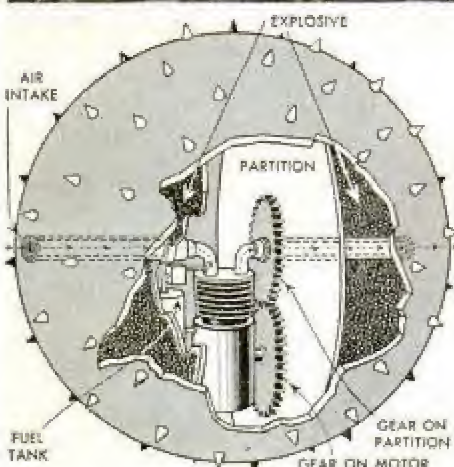
Westbound, this cargo plane brought a load of steel mats to build a new air field somewhere in New Guinea. Eastbound again it will take aboard the soldiers waiting under wing, just relieved of duty



Del. March.
 6626 Franklin Ave.
 Chateau, Des Fleurs, Hollywood, Calif. N 703

Rolling Bomb Runs Wild Among Enemy Troops

Inv. J. L. Conrad, 2148 Yorkville Rd.
 Columbus, Ohio
 N.Y. 2, 327, 621



Dropped by parachute, spiked bomb continues to roll. Cutaway shows how motor makes it creep off center, causing it to move

Dropped by parachute, and rolling erratically among enemy forces, to explode no one knows when nor where, a rolling bomb invented recently is meant to spread terror among enemy troops. It is studded with projecting spikes, to give it a better grip on the ground. Its motion comes from an internal-combustion engine suspended inside the sphere. This engine's operation causes it to "creep" off the center of gravity, and the sphere moves to compensate; thus, continuous motion is achieved. Since its direction of travel is dependent upon its center of gravity, and that changes with every obstruction it encounters, the path of the bomb would be completely unpredictable.

Mildew in Textiles Is Overcome by Inexpensive Chemicals

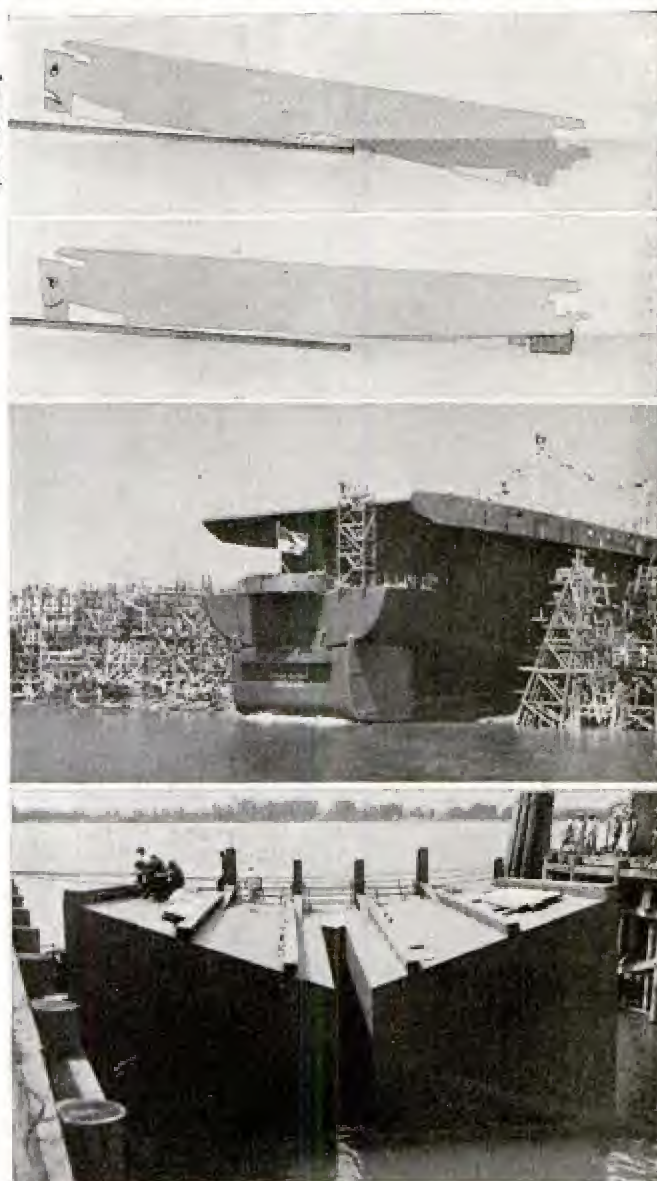
Textiles are made completely antiseptic, and given lasting resistance to bacteria and fungi by use of an inexpensive chemical formula, now being applied to safeguard military equipment from mildewing. Besides millions of yards of duck, mosquito netting, ground cloth, Signal Corps material and other military fabrics, over 20 million pairs of shoes have been given linings treated to eliminate loss from mildew, as

well as to safeguard the shoe lining from the organism associated with athlete's foot. The chemical process first makes the cloth antiseptic, so that it may, as it were, have a "clean start." Next, the process imparts a high degree of immunity to the attack of both bacteria or fungi, either of which may weaken or even destroy fabrics. Specifically, the treatment safeguards against the attack by the common saprophytic fungi.

Galloway & Co.
 N. Y. N. Y. 304 C. 23rd.

"Bustle" Lifts Carrier's Stern for Safe Launching

"Hull No. 350½," or "Little Audrey" is the name of a strange supplementary craft used at the Kaiser Company's Vancouver shipyards. In reality, it is a "bustle" for the yard's escort aircraft carriers. By utilizing it, the yard prevents possible damage to the ship's plates during launching. The problem arose because of the Columbia River's habit of varying 20 feet or more in depth between high and low water. During low periods, about four months each year, the water's depth is insufficient to float the ship before it comes to the end of the ways. These ways were originally constructed for Liberty ships, but the yard was later turned over to the construction of escort carriers. In shallow periods, then, the stern of a launched ship would sink abruptly and the bow rise, leaving the huge vessel teetering on the edge. After such a rough launching, doubtless buckled plates would be found. The carrier also has a "transom stern," with relatively little buoyancy, aggravating the problem. One solution would have been to build the 12 ways 80 feet farther into the river, but this would have tied up the ways for some three months, and cost about \$250,000. Instead, C. F. Haughey, naval architect, in 11 days designed and built a steel pontoon, costing only \$15,000, weighing 90 tons, but with a buoyancy of over 500 tons. It tucks neatly beneath the stern of a carrier, and has the effect of raising the river level about three feet. When the ship is safely launched, the pontoon is removed from beneath the hull.



In shallow periods, launched carrier teetered on edge of ways, top. Floating "bustle" raises stern, second drawing. "Bustle" is steel pontoon, shown at launching and (bottom) in closeup

71770

Composite Soldier Is 5 Feet, 8 Inches, Weighs 144 Pounds

From averages compiled in the Philadelphia Quartermaster Depot, this is a description of the average Army recruit: He is 5 feet, 8 inches tall, weighs 144 pounds, has a chest measurement of 33¼ inches, a 31-inch waistline, wears a size 9½D shoe and a size 7 hat. After a few months in the Army, he puts on weight, expands his chest measurement, and wears a shoe one-half size larger. To keep him in fighting trim for the first year, the Quartermaster Corps spends \$226.30 for his food, \$190.23 for his clothing, \$57.42 for his individual equip-

ment and \$27.11 for his barrack equipment, a total of \$501.46. His food averages 62 cents a day. Regular G. I. clothing costs from 5 cents for a cotton handkerchief to a top of \$15.50 for a wool overcoat. Individual equipment costs from 5 cents for a "dog tag," to \$22.07 for three woolen blankets. Barrack equipment ranges from a 31-cent pillow case to a \$7.16 bedstead.

¶In one hour, a 4-engined bomber burns as much gasoline as the average family automobile uses in six months.

PLANT MAGIC

WITH half a teaspoonful of chemicals you may become a plant wizard and play tricks on nature that Luther Burbank never achieved.

You can create giant flowers and fruits, stunt other plants into dwarfs only a fraction of their normal size, and grow freaks that may develop into new and valuable types.

You can bring sick plants back to life, produce "fatherless" tomatoes that contain no seed, and even cause a plant to grow roots high on its stalk. Then, if you like, you may dig this plant up and replant it upside down, with the foliage buried and with the roots in the air. After a period it will adjust itself and start new branches above ground.

All these things and more can be done with the aid of newly discovered synthetic plant hormones and vitamins. Some of the things these chemical compounds do are pretty mysterious or, as one farmer puts it, "We don't understand all we know about them." Essentially they are tools by which the growth of plants may be regulated.

Translate that statement into

Chemical applied to tomato plant's stem causes roots to appear out of place, on the stem itself



Cutting from tomato plant that grew roots in air—planted upside down, but still growing. Branches to come will grow upright



Agricultural miracles are being accomplished by use of synthetic plant hormones and vitamins. In two pictures above experimenter shows how plant may be made to grow topsy-turvy. At left, chemicals produce tremendous root on a small tomato plant. In five weeks roots filled the pot, dangled out of hole



Dr. George C. Warner
181 C. California St.
Pasadena, Calif.



Chemicals caused varied growth in citrus fruit, above. Interbreeding may develop desirable characteristics. Left, growth hormones injected into an already frost-proofed cinchona shrub, source of quinine

other words and it means that agriculture has found a way to grow and harvest larger crops of better quality. Chemicals are being used to induce sprouts to break through the ground faster, to develop larger root systems for sturdy growth, and to achieve uniform, ripened fruit. Some of the new hormones aid in the control of pests. Others may be used to slow down normal

growth, something that can save a crop if unseasonal warm weather starts it growing before the danger of frost is past.

One hormone sprayed on apple trees makes the fruit "stick" until they are ripe, eliminating losses from fruit drop and windfalls. It is even possible to prevent some vegetables from sprouting in storage by spraying the bags with one of the new substances.

These miracle-producing compounds are known by such technical names as indole-acetic acid, levulinic acid, naphthalene-acetamide, and Vitamin B-1, among other vitamins.

George C. Warner, who did the original research in the use of Vitamin B-1 on plants, uses these and other substances to do lots of things that "can't be done" in his laboratory in Pasadena, Calif. Warner squirts a drop of liquid in a vase, and the cut flowers that it contains remain fresh for a week. He soaks camellia cuttings, extremely hard to root, in a waterlike liquid before planting them, and they develop healthy root systems in a couple of weeks. With Vitamin B-1 and other chemicals he can grow roots on practically any cutting



Attaching cotton wicks, left, that take up chemical from glass tubes to leaves of plant, which absorb it. Below, treating tree with solution to make it bear earlier in the year

that has live bark on it, and make it grow. Vegetables, flower plants, shrubs, and trees that he treats mature faster, have better appearance, and are sturdier than are plants that receive no treatment.

Today you can duplicate many of the miracles that Warner and other research men are performing. Many of the chemicals they use are on the market, usually made up into mixtures that contain various growth-stimulants, and are for sale at many seed stores and agricultural establishments.

Different mixtures are used for different purposes and you should specify a type that has been tested for the results you desire. In a few cases you may be disappointed, for not all plants receive as high a stimulation from the hormones as do most others. Too, the chemicals can't produce startling results in soils that are highly alkaline.

Follow the directions sparingly in using any of the new growth-stimulants. One drop of solution to five gallons of irrigation water or spray is the usual dose. A strong concentration of indole-acetic acid, for instance, kills a plant. A weak solution of the same material stunts a plant and makes it mature as a dwarf, while an extremely weak solution of the same material has an opposite effect and makes the plant flourish.

To experiment with developing new characteristics in plants you use a different kind of chemical from those mentioned above. Colchicine is one substance in this group. Colchicine is an active poison, extracted from the root of the autumn crocus, and was once a popular gout remedy. Your druggist can order colchicine for you. Like the other plant chemicals, a tiny bit is all you need. One gram of colchicine dissolved into a pint of distilled water, to be diluted



Below, roots of derris plant, source of insecticide acclimated to California by the magic of chemistry



further for use, or 10 mg. of colchicine mixed into one gram of lanolin fat, is enough for many experiments. Keep either mixture off your hands and face, for it is a dangerous internal poison.

Colchicine seems temporarily to paralyze the process of cell division in a plant and this causes a doubling of the chromosomes in the parts affected. Chromosomes are a plant's heredity factors, hence any change in their number also changes the characteristics of the plants. These changes become apparent in the second generation.

You may soak seeds for a few hours or days in a dilute solution of colchicine, dry them, then plant as usual. It's hard to predict exactly what the results will be. No doubt the plant will grow into a twisted, malformed specimen and grow flowers of odd appearance.

The seeds from these flowers are the ones that may produce oversized foliage and giant flowers and fruit. Save the seed and replant them. Possibly the seed will be sterile; possibly the seed will produce plants that bear earlier, or that are drought resistant, or



Distillation apparatus to extract oils from tissue of plants

that have other new characteristics. The only way to learn results is to follow the experiment through.

Instead of soaking seed in the solution you may use a few drops of it in water as a spray, applying it to plants several times a week over a period, with

(Continued to page 148)

How chemicals are injected into tree tissue—here, an acclimated papaya



Bicycle Built for Three Has "Bathtub" for Baby



Metal joins bicycles and supports a special car for the baby

One family solved its transportation problem by joining two ordinary bicycles with metal tubing which also supports a "bathtub" for carrying the baby. The baby's de luxe compartment is equipped with a windshield and overhead awning. The non-tip, triple seater was built by John Pittman of Burlington, N. J.

71790

Plan Aerial 'Queen Mary' For \$200 Ocean Trip

Construction of a 130-ton "Queen Mary" of the skies for transatlantic service has been authorized by the British Ministry of Aircraft Production. It will be built by the Bristol Aeroplane Co., builders of Blenheim, Beaufort and Beaufighter warplanes. Though details are secret, the huge airliner is expected to be revolutionary in structure, motive power, and shape. Its special motors will total 20,000 horsepower, and its cruising speed will be about 250 miles an hour. It is expected to carry 150 passengers across the Atlantic for about \$200 a person.

71648

Electric Iron Steams Clothes and Switches to Dry Ironing

Dampening of cloth before ironing is eliminated with an electric iron that projects horizontal jets of steam. The flip of a switch turns off the steam, and the iron

is ready for conventional dry ironing. It is provided with a thermostatic control. This timesaver will not be manufactured for general distribution until after the war.

71762

Surefire Exploder for Gas Mine Withstands Friction or Flame

Developed as a peacetime mining product, an exploder for chemical land mines will give the Axis plenty of trouble if poison gas is introduced in the last stages of World War II. The exploder, known as primacord, can be laid for miles on land or in water. The cord explodes at the rate of three-and-a-half miles a second. It withstands friction, and can be hammered and burned without exploding. Primacord has been widely used by the Corps of Engineers in demolition work. Enemy troops can be slowed by gas mines, just as they are today by land mines and booby traps.

Write to the firms listed in the Where-to-Buy-It index, page 4A, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.



Flipping switch turns on horizontal jets of steam to dampen the clothes before starting dry ironing

Concrete "Semisubmarine" Cruises at 20 Knots



Superior performance and lower construction cost are claimed for the concrete, cigar-shaped cargo vessel pictured here. It is termed a semisubmarine, because of its shape and because of the fact that in the water it rides about three-fourths submerged. Streamlining, with consequent low skin friction, is said to be responsible for its unusual speed. Its weight is 2,200 pounds, and it is powered with two Ford V-8 engines, yet it has been timed at 16 to 20 knots. Much higher speeds, however, would be possible with marine engines of more horsepower, Hal B. Hayes, inventor and builder, maintains. Above, the craft was built outdoors, in a field. Right, details of construction of the hull. The ship is constructed almost entirely of a patented mixture of concrete, applied over a wire mesh, internally supported by previously cast rings of concrete



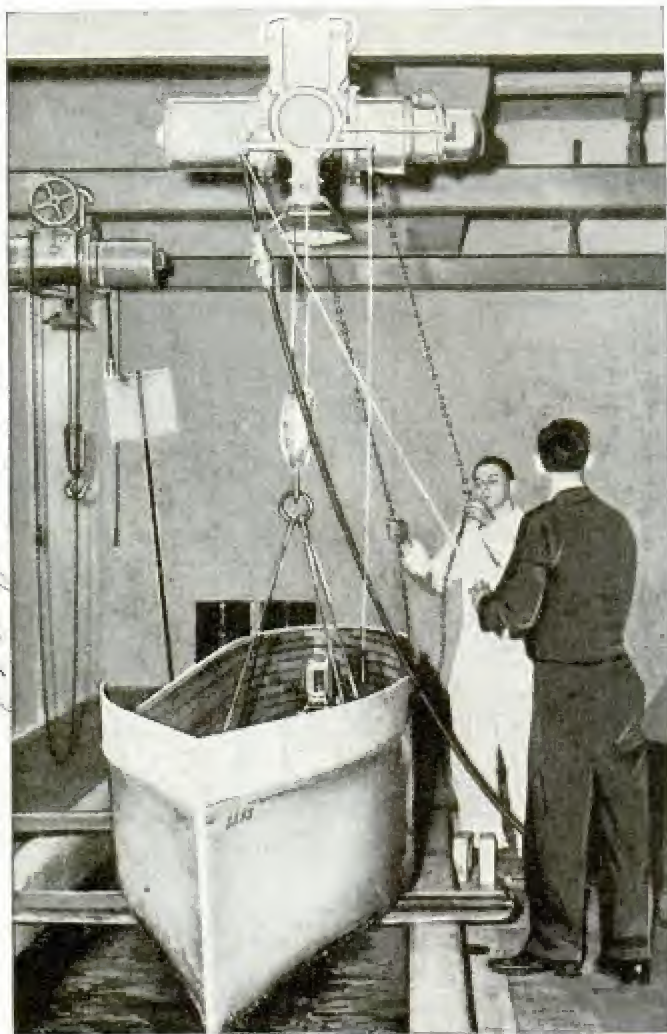
Views of the semisub at launching, left, and afloat, above, emphasize its unusual design. It is 125 feet long; its beam is only seven feet. Using the same design, the inventor says he could build a ship similar to the 10,500-ton Liberty class in less time, using only a tenth as much critical materials. Such a craft would be 700 feet long, with a beam of 40 feet. With the same power as the Liberty ships, Hayes says its speed would be in excess of 50 knots. The inventor also has offered to close the hatches of his experimental craft and turn it completely on its side in the water. Its design is such that it will then instantly right itself, he says

W. Grant

71398

UNCLE SAM'S TOM THUMB NAVY

American Forest Products Industries, Inc.
16 East 43rd St.
N. Y. C.



with hand tools 200,000 board feet of western pine per year serve as the control key to the battle supremacy of American ships. A \$400 western sugar pine model may save years of time, millions of dollars and thousands of fighting men's lives.

The Navy's model basin, one of 40 in the world, is the newest, built to produce the greatest test accuracies. Our allies, with model basins of their own, send over plans of their fighting ships to be modeled and tested at Carderock.

At all foreign test basins the models are made of paraffin. Ours are made of sugar pine, Idaho white and Ponderosa—all western white pines. There could be no worse military practice than to tie a key operation to a material wholly controlled by a potential enemy. We control the source of western pine, available in no other part of the world. American operators grow it on 10,000-acre tree farms. Other nations make shift with paraffin models.

At left, hoisting a model hull from the basin after a test. Below, model builders put finishing touches on a miniature ship. U. S. Navy photos

AIRCRAFT carriers lost in battle might still be alive if they had been able to dodge a little faster, pivot out of the path of an enemy bomb or torpedo. They needed the footwork of a boxer dodging a fist. Maneuverability is the surface vessel's best answer to attack.

Our new flattops have it. The new Lexington, Yorktown and other carriers just built or building can play tag with enemy tinfish like a frisky waterbug.

For these new seagoing airfields were built to designs tested and perfected in the Navy's David W. Taylor Model Basin at Carderock, Md. The intricate details of design of the 1943 carriers are a secret our enemies would like to break open. What they do know is that our naval architects demonstrated exactly how these ships will behave in action long before the keel was laid—for the design was created and proved in 20-foot models made of wood. At Carderock 75 skilled woodworkers carving



Until about 1870 no one could know, before a ship had its trial runs, just how it would perform—its speed, maneuverability or cost of operation. Then William Froude, an English engineer, began building models to scale and amassing comparison data by towing them at various rates of speed. Performance depends on size, sleekness and shape of the hull; on weight, superstructure arrangement, power plant, shaft and propeller design. Froude found that a model built to exact geometrical scale and towed to a certain ratio of speed would tell the designer what the full-sized ship would do. Some nations were slow in adopting his teachings. A few years before the last war visitors saw tied up at a Hamburg, Germany dock a brand new luxury liner consigned to rust. Its first transatlantic trip proved it could not meet competitive speeds and earn its fuel. Model tests would have averted that failure.

The Carderock basin is a massive laboratory embracing five towing canals. Its monolithic concrete walls are joined directly to bed rock, helping to insure accuracy by virtually eliminating vibration.

A layman untutored in marine mathematics might guess that a model one-tenth the size and with one-tenth the power of a full-sized ship would have the same rate of speed as the large vessel. That is not the case. Froude evolved a formula of "corresponding speeds." If a model is built exactly to geometric scale and towed under laboratory conditions, the "corresponding speed" is the square root of the ratio of the length of the model to the length of the



↑
The famed battleship Oregon was scrapped recently, but it lives in a Carderock model

Women are building scores of ship models on 1 to 500 scale for identification study
↓



Here, in miniature, is the Japanese fleet—the carrier *Soryu* at top—reproduced to help Navy airmen and deck officers recognize them

full-sized ship, multiplied by the given speed of the large craft. A 14-foot model towed at 3.85 knots has the corresponding speed of a 500-foot ship running at 23 knots. A 10-foot model of a 100-foot ship, towed at 20 knots, corresponds to a ship speed of 63 knots. By similar computations in model tests the engineers learn how much resistance to the water the large ship will offer at any given speed and how much propulsive power is necessary.

Water resistance consists partly of fric-

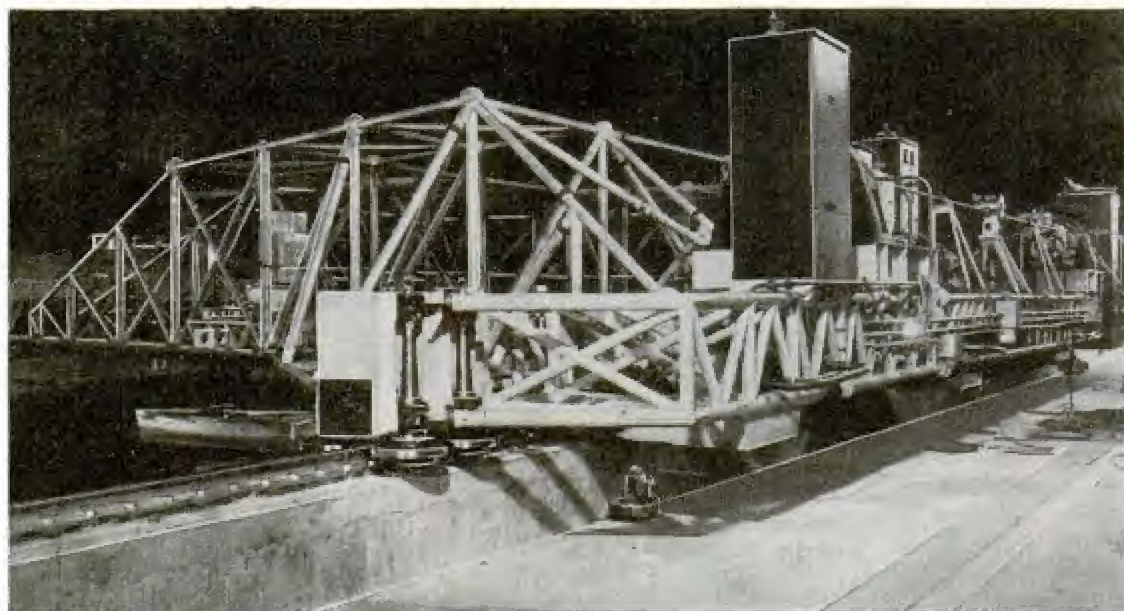
tion between the water and the subsurface hull, partly of residual resistance caused by waves, eddies and other disturbances created by the hull form. Frictional resistance can only be decreased by producing a smoother hull surface and decreasing the underwater area. The residual resistance can be lessened by changing hull design.

When Congress authorized the heavy cruisers of the Salt Lake City class, requirements were 10,000 tons displacement with speed as high and better sea-keeping characteristics than any existing destroyers. That problem was the model tester's dish. A series of wood models were tested, changed and tested again, and came out with an en-

tirely new underwater stern, a new midship section and a bulb bow. Full-sized vessels made 32 knots.

That is the sort of development born of test-model practice, which is producing new ships for this war. Destroyer escorts are in point. They are new, designed expressly for convoy duty, created to quell U-boats. Equal in fighting power to last war's destroyers, they are smaller, much faster, and can spin almost within their own length to catch a dodging submarine.

This is the towing carriage on Carderock's deep basin. The tower is part of electric power supply system



Almost at the other extreme of new design are invasion ships, big armed vessels built to carry battle cargo. Some carry tanks. Arrived at a hostile shore, down goes the front end of the vessel's hold to make a steel bridge over which armored land fortresses roll to blast out a beachhead. Somewhat smaller vessels are designed to put foot soldiers ashore with equal speed. The first of these got their baptism of fire in North Africa.

Demands on the designers of the new aircraft carriers were enormous. Decks big enough to deploy more than 100 warplanes. Elevators that can deliver planes from storage deck to flight top in less than 10 seconds. More spacious holds to carry more gasoline, protected with new types of equipment and better fire control, all adding to deadweight. Heavier underwater armor. Altogether, a ship with displacement raised to 25,000 tons, able to make longer voyages and carry more airplane fuel than any before designed, and be the fastest and most maneuverable carriers afloat.

The woodworkers who make the Carderock models are all old patternmakers. A hull model is built up in rough outline of two-inch thick planks pinned together with wooden dowels. Then it is taken down and the wood layers smeared with water-



Skilled patternmakers using hand tools carve geometrically accurate models in western pine of combat and merchant ships

proof resin glue applied hot. Reassembled, the block is placed in a 1,200,000-pound press; after 16 hours in the press it is solid. Then it is blank-contoured in a profiling machine, the only machine tool used. The rest of the modeling is skilled handwork with gouge, chisel, spoke shave, plane, sandpaper.

Once a model has been perfected it is kept on file until the ship it represents is out of commission. Wood models can be stored safely for decades without distortion. The standard model is 20 feet long; some have been 60 feet long. The 20-foot model weighs a ton. Equipped with motors serving also as dynamometers, test propellers, and driven at full model speed of six knots (corresponding to 33 knots for a 600-foot ship) the rudder is turned full over and the model brought up after a 90 degree turn,

(Continued to page 146)

Ballasting a model to bring it to proper waterline before giving it a self-propulsion trial



Submerged Air Jet Quiets Waves Beside Ship



Compressed air jet (inset) creates "water dam" in path of approaching waves, calms them for plane landing

Calm areas at sea, sufficiently large to permit the landing of a seaplane alongside a ship, may be produced by the use of air under pressure. As described in a patent issued to Philip Brasher of Kent, Conn., the method involves the creation of an upwardly moving wall, or dam, of air and

water, in the path of the waves approaching the ship. This dam is effected by the discharge of air from a flexible conduit towed by the ship. In such a quiescent area, the water would be sufficiently calm for lowering a plane into the water for a takeoff, and also to permit a landing.

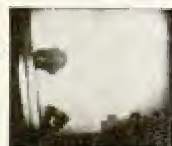
Film Travels at 70 Miles an Hour in Industrial Camera

With a top speed that exposes 8,000 "frames" a second, the film in a movie camera developed by the Bell Telephone Laboratories travels 70 miles an hour. This camera, manufactured by the Western Electric Company, reveals the secrets of mechanical parts that move at lightning speed. It has a continuous film drive, as

distinguished from the stop-expose-advance cycle of ordinary cameras. Exposure of the frames is accomplished by a revolving prism acting as an optical compensator. The camera, using 8 mm. and 16 mm. film, has detected hidden flaws in signal relay devices in telephones, weak parts in equipment broken experimentally before the

camera, and factors causing noisy operation in machines operating at high speed. It has even been used to study the action of the vocal cords in reproducing speech. The versatile camera has a film travel range from three to 70 miles an hour, and is adaptable to either black and white or color, and the photography of self-luminous objects.

☞ Farmers and railroads use 40 million pounds of weed killing chemicals in an average year.



"Shooting" vocal cords with mirrors; at right, telephone breakage test

44 Western Electric Co.
195 Broadway
N. Y. 7, N. Y.

Special "Lung" Lifts Fighter Two Miles Higher 77 641

INTERCEPTION ZONE FOR HIGH-FLYING BOMBERS



ALTITUDE LIMIT WITH
2-SPEED, 2-STAGE
SUPERCHARGER



PILOTS NEED
OXYGEN IN
UPPER ZONE



ALTITUDE LIMIT WITH
2-SPEED SINGLE-STAGE
SUPERCHARGER

EFFECTIVE CEILING
ANTI-AIRCRAFT FIRE



AT THIS POINT, SUPERCHARGER AUTOMATICALLY
SHIFTS TO SECOND SPEED, INCREASING ALTITUDE
RANGE BY TWO MILES



ALTITUDE LIMIT WITH
SINGLE-SPEED, SINGLE-
STAGE SUPERCHARGER



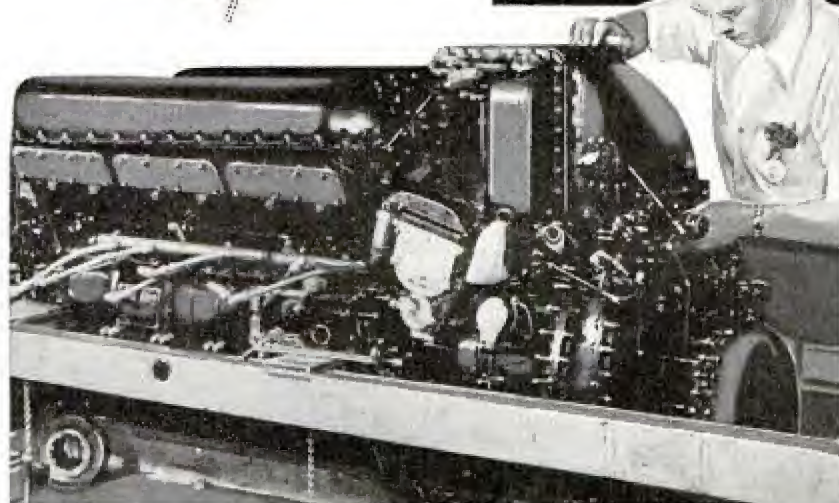
ALTITUDE LIMIT
WITHOUT
SUPERCHARGER



STRAFING, DIVE BOMBING ZONE



Above, fitting heated
units of supercharger
to shaft; left, adjust-
ing the supercharger



Aerial warfare has zoomed two miles higher into the stratosphere with an improved engine and supercharger now powering the North American P-51 Mustang fighter. The new type Rolls-Royce engine, built by the Packard Motor Car Company, incorporates a two-speed, two-stage supercharger. In the past, similar engines also used in P-40 Warhawks, British Hurricane fighters, the big Lancaster bombers, and Mosquito fighter-bombers, have featured a two-speed, single-stage super-

charger. In the two-stage supercharger, the first rotor compresses the air comparable to that of a single-stage supercharger. The air then passes to the second rotor which compresses it to six times the surrounding atmospheric pressure, enabling the plane to fly more than 10,000 feet higher. The new operating altitude is believed to be higher than that achieved by any enemy fighter plane. Speed, armament, and weight are also restricted, but in a recent test the plane flashed across a field at about 25 feet and was out of sight in 15 seconds. The two-stage supercharger is housed in a regular supercharger unit at the rear of the engine with a cooling device directly forward. The air, heated by intense compression, must be cooled before delivery to the engine.

TRICKS of the BATTLEFIELD



Norman

At an Ordnance depot in Texas, soldiers learn to remove damaged trucks and other vehicles from a battlefield. Tricks of the wrecker service are pointed toward maximum speed and minimum additional damage. Above, a wrecker lifts truck out of ditch. It can raise 5 tons from deep ravine

Vehicle minus rear wheels (above) can limp from battlefield on two logs in a slanting position with front wheel drive pulling car

Right: With this method, a truck loaded with TNT can be righted safely. Using both booms of wrecker, truck is eased gently to ground

The hookup shown below is used to evacuate vehicles that have no wheels. Notice how the cables lift rear as well as front of the car



WRECKER SERVICE



Lifting an Army car with a derrick that is more often used to lift large objects into trucks. The boom is free to swing around the mast. This is one of many devices with which the graduates of wrecker course are familiar



Timbers crossed in shape of an "X" (above) lift the front end of a heavy truck off ground with its own power. Timbers are attached as shown in inset, and holes dug to receive feet of frame. Backing up truck forces timbers upright. To completely suspend vehicle (left) a third member added to frame prevents fore and aft movement

Below, small vehicle is pulling two large cargo trucks that have their brakes locked with tires sliding. The trick is done with a small winch, its power multiplied with rigging shown at right



Dummy Sniper Operated From Pit As Safeguard Against Bullets



Dummy-operator stands in pit to avoid sharpshooters' bullets

When soldiers at a Northwest fort demonstrated the storming of a supposed Nazi-held town, they were on constant lookout for "snipers," dummy figures representing Nazi sharpshooters. With customary alertness, the Yanks filled the dummies with lead as soon as they showed at windows of the "Blitzburg" homes. As a protection against live bullets, operators of the dummies were stationed in pits, from which they yanked cords that made the "snipers" appear.

Shoe for Ski Troops Cleans Self With Special Rubber "Tread"



Perfect traction on stone and ice is provided with a self-cleaning rubber sole and heel designed for ski troopers' boots. The rubber sole, developed by the

Goodyear Tire & Rubber Company, not only wears longer than the conventional steel cleats, but weighs less and is noiseless. Muffled steel cleats used by mountain

troops in World War I often caused accidents. The tread of the sole is designed in such a way that the boots automatically clean themselves of ice and snow each time they are flexed.

Grease for Substratosphere Has Special Soap Base

It looks like ordinary butter, but the grease that keeps airplane controls working smoothly in substratosphere cold or desert heat is anything but ordinary. Developed by Standard Oil Company of New Jersey scientists, this grease lubricates smoothly through a temperature range from 75 degrees below zero Fahrenheit to 175 degrees above. The grease, which has a special soap base, withstands pressure as well as temperature variations. The entire production of this lubricant, known as Beacon Lubricant M-285, is now allocated to the armed forces, but it is expected to play an important role in postwar stratosphere flying.

Face Shield for Hard Hat Snaps to Clipped Frame

Attachable to any protective hard hat is a plastic visor that adds face and eye protection. Its two-piece construction consists of the visor and a frame assembly. The frame clips permanently to the brim of the safety hat, and the visor is attached to this band by means of three snap fasteners, whenever face or eye protection is desired.



Plastic face shield clips to fixed frame on hard hat

POPULAR MECHANICS

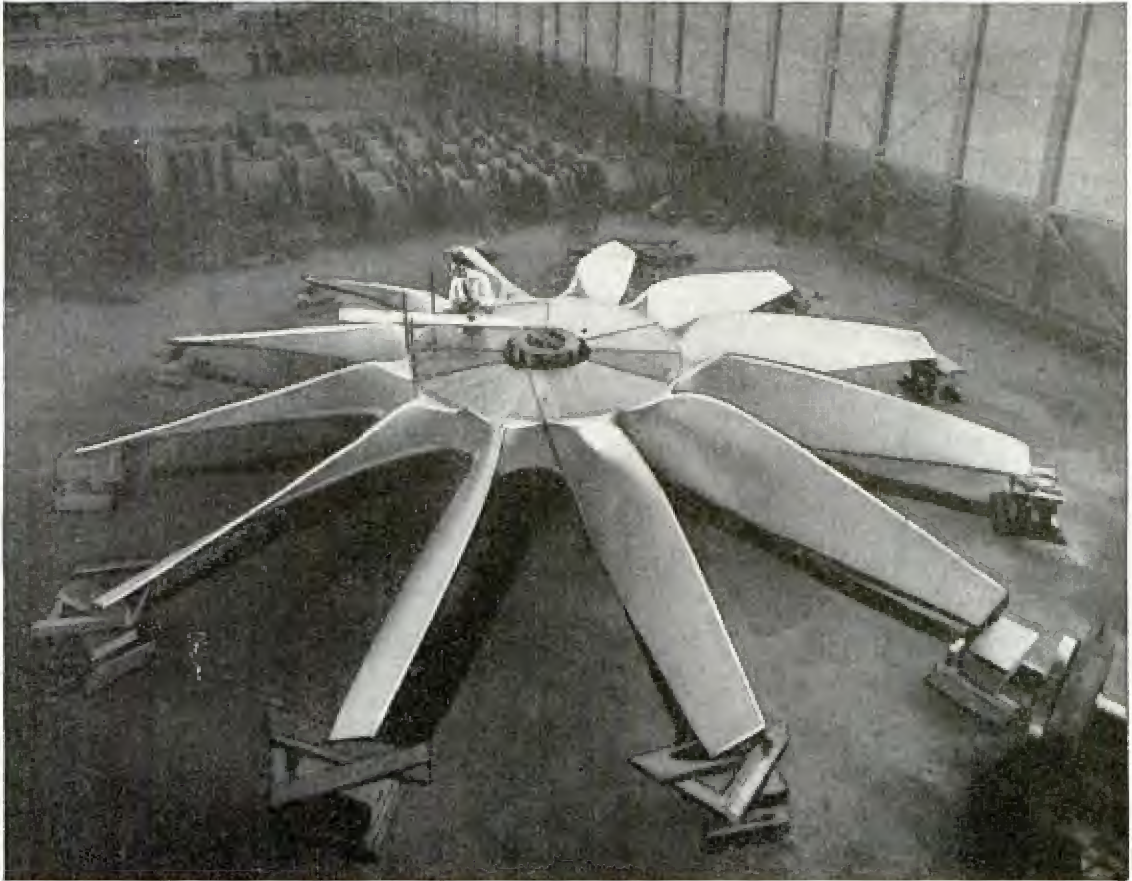
B. F. McSmall Co., 1250 S. Hope St.
Los Angeles 15, Calif.

Opfr. Nov. 2 McSmall Co. N.Y.C.
at 7th Street Wash.

71658

71669

Stratosphere Fan Blows Air 500 Miles an Hour



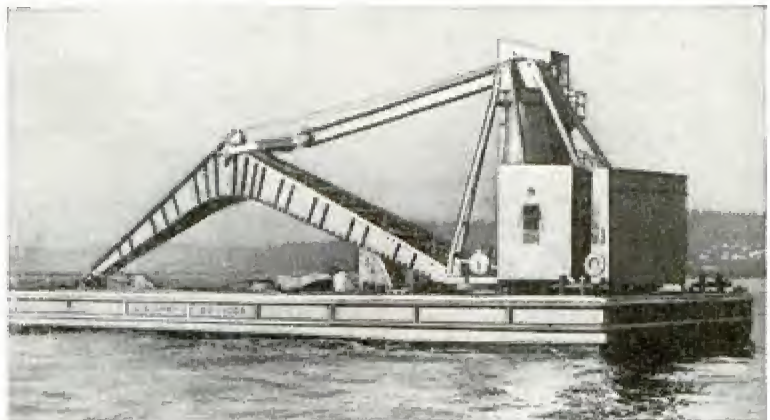
Wind-tunnel blasts up to 500 miles an hour are possible with this fan, powered by an 18,000-horsepower motor

Twelve enormous blades of laminated wood form the fan for a high-altitude experimental wind tunnel being built by the National Advisory Committee for Aeronautics at Cleveland. The fan will produce wind velocities of 500 miles an hour. A complete aircraft engine nacelle can be mounted in the 20-foot throat of the tunnel. The air pressure and temperature may

be reduced to those corresponding to any altitude up to at least 30,000 feet, where the pressure is only 8.9 inches of mercury and the temperature is 48 degrees below zero. An 18,000-horsepower motor drives the fan. Others totaling about 30,000 horsepower, drive the refrigerating and vacuum pump equipment. The tunnel will accommodate engines of up to 4,000 horsepower.

Floating Crane With 30-Ton Lift Unloads Ship's Cargo

At ports lacking docking facilities, war materials are unloaded with a crane mounted on a barge. The crane-barge, specially built for the army, can lift 30 tons with power supplied by a 100-horsepower Diesel engine. It is designed to operate close to cargo ships.



Crane-barge built for army makes it possible to unload supply ships at remote ports lacking docking facilities

PHOTOS *without* FILM



Top to bottom, paper negative taken by synchronized flash; print from paper negative, and enlargement made from it

CAMERA film is scarce today, but by using photographic enlarging paper in place of film you may still take as many pictures as you wish. Sensitized paper is coated with an emulsion similar to that on film and is suitable for the ordinary run of snapshots, and may even be used for time exposures or synchro-flash shots.

The disadvantages of paper as a negative are that it is much less sensitive to light than is film, hence requires greater exposures, and it has much coarser grain. On the other hand, paper is not rationed, is cheap, may be developed by inspection under a photographic yellow safelight, and produces pictures quite satisfactory for most purposes.

Use projection paper instead of contact paper, because the latter is even more insensitive to light. A single weight paper with a glossy surface in Grade No. 2 or No. 3 will provide detail plus contrast, although you may experiment with papers that are harder or softer in quality.

Paper film is not satisfactory in the inexpensive fixed-speed cameras because these don't permit the greater exposures that are necessary, and in miniature cameras it is difficult to wind the stiff paper around the small spools. In most other cameras, however, paper may be used without trouble.

For a cut film camera, cut the paper to the same size as the film you have been using and insert it in the film holder. To load a roll film camera with paper you need two film spools. Cut several strips of enlarging paper from an 8x10 sheet to a width that fits the camera spools. Glued end to end, these strips will provide a continuous strip long enough for several exposures. Seal the exposure number hole in the camera's back with adhesive tape to prevent fogging the paper. By placing an old strip of exposed film in the camera you can check on the number of turns necessary to move the film enough to prevent double exposures.



Above, inserting paper into film spool, emulsion side in. Below, load paper negative in darkness or by safelight



Old camera above was modernized with flash gun, range finder, new front shutter, and other accessories. Below, retouching air brush uses compressor and tank units from refrigerator

To load the camera with paper, simply load one film spool with the paper strip, emulsion side in; lead the balance of the strip across the back of the camera and attach its end to the empty spool as usual. The whole job must be done under a yellow safelight in the darkroom.

Operate the camera exactly as if it were loaded with ordinary film but remember that your exposures must be greater than with film. Try $1/10$ th of a second instead of $1/50$ th of a second, or shoot at $1/25$ th and open the diaphragm several more stops than usual. Enlarging paper is comparable in speed to color film. Try a number of different exposures, keeping a record of what you do, to learn the optimum exposure.

Develop your paper negative in a standard developer solution, by inspection under a yellow safelight. Fix it in hypo and wash and dry it in the usual way.

The result will be a negative image on opaque paper. However, this image is more trans-





Ordinary "8x10" is converted into an enlarger with homemade lamp house

parent than it appears to be. Use it exactly as if it were an ordinary film in making a print, placing it emulsion to emulsion against an unexposed piece of the same grade of paper in a printing frame. An exposure five or six times longer than with film will give good results and will provide a key for the correct exposure time. Develop and fix the exposed paper positive print in the ordinary manner.

The negative paper image may even be used for enlarging. A test exposure several times longer than with film will indicate the length of exposure required. Grain, which results mainly from the texture of the paper negative, will be noticeable in the enlargement and produces a quite artistic effect if the enlarged print is made on rough paper.

This winter can be a good time to make some improvements in your darkroom equipment. One camera fan converted a big 8x10 studio camera that he uses for copy work into an enlarging projector, simply by building a wooden lamp house that is attached to the camera's back when needed. The ground glass and plate holder at the rear of the camera are removed and the lamp house is then hinged into place. The negative holder slides into an opening at the front of the lamp house.

If you wish to make photographic copies of letters or documents you may build your own photostat machine. This produces true duplicates without the usual intermediate step of making a neg-

ative although, like blue printing, blacks and whites are reversed. A photostat of this page would have white letters on a black background.

The photostat camera described here is compact, costs no more than a few dollars in addition to its lens, and performs work of professional quality. Essentially the camera consists of a box with one end hinged to open so that the material to be copied may be thumbtacked to its inner surface. Offset lamps illuminate this surface.

Beyond the midway point in the box is a sliding plywood partition, mounted on shoulders padded with felt so that no light may leak past the edges. A lens, even one from a moderately priced camera, is mounted in a hole in the center of this partition.

The image of the letter or document to be copied passes through this lens and strikes a front-silvered mirror mounted at an exact 45 degree angle at the far end of the box. From this surface the image is reflected through a glass window directly above the mirror. Photostat paper or photographic contact paper pressed emulsion side down on the glass window will be printed just as in a contact printer, and

Homebuilt paper holder for enlarging or copying made of shallow tray with tacky surface of hardened hectograph compound



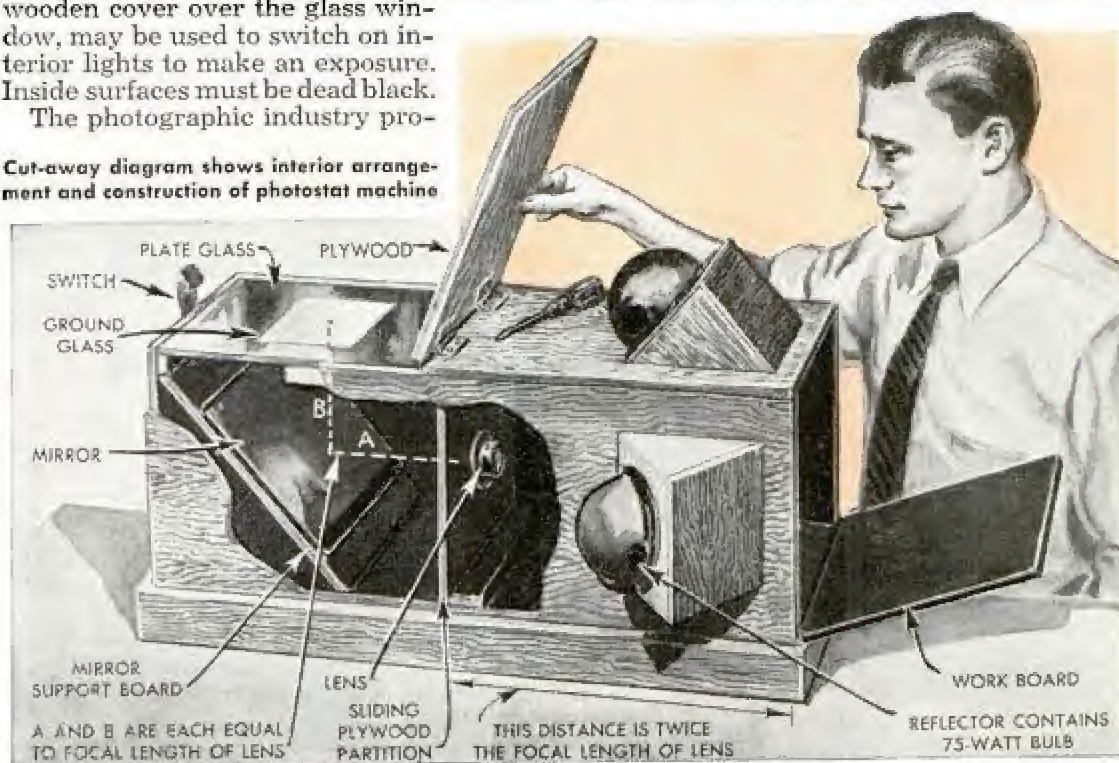
may then be developed and fixed by ordinary procedure. A small piece of ground glass, say 5x7 in., placed ground side down on the window may be used for focusing and inspecting the image, then removed to permit making the print.

Dimensions of the box and its optical system depend on the focal length of the lens. The distance from the copy board to the lens must be twice the focal length of the lens, and the distance from the lens to the center of the diagonal mirror must equal the focal length of the lens. The distance from the center of the mirror to the top of the glass window must likewise equal the lens's focal length. Thus an 8-inch lens must be placed 16 inches in front of the copy board, with the mirror eight inches beyond and with the glass window eight inches above the center of the mirror.

For a lens of this focal length a box with outside dimensions of 14x14x31 inches will do very well. Stop the lens down to f:11 and slide the lens partition back or forth until the reflected image is the size of the original material. An automobile stoplight switch, actuated by pressing down the wooden cover over the glass window, may be used to switch on interior lights to make an exposure. Inside surfaces must be dead black.

The photographic industry pro-

Cut-away diagram shows interior arrangement and construction of photostat machine

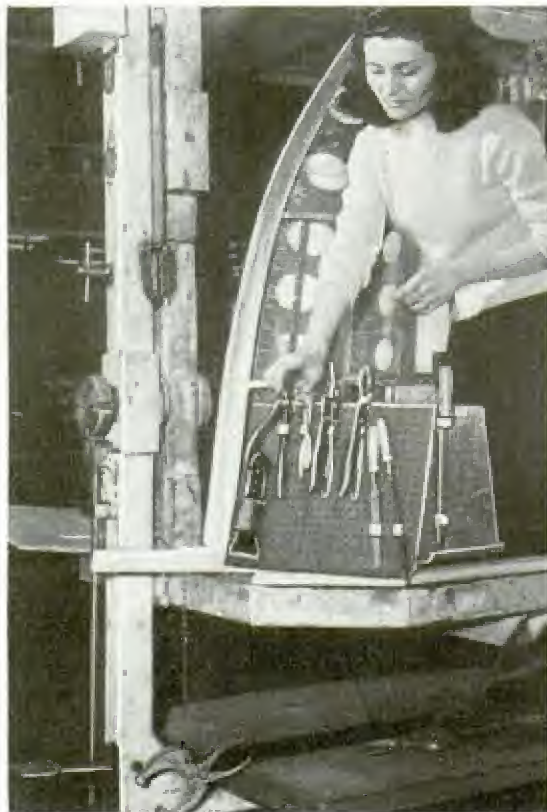


Placing a photograph on work board of the photostat machine for copying

duces a wide range of special papers, some of them scarce as film. Reflex copy paper is one. It has the unique ability to copy by reflected light. Reflex paper is placed in contact with the document to be copied, an exposure from an overhead light source is made, and the paper is then developed. From this a positive print may be made.

Direct positive paper is coated with a reversal emulsion so that it may be exposed as if it were negative film. It is then developed, bleached, and re-developed in special solutions to make a positive print.

7666 "Inside-Out" Kit for Tools Holds Them Within Reach



Clips inserted in perforations hold worker's tools

Aircraft workers can increase their output with a portable tool kit that is made "inside-out." The tools, held by removable clips that are inserted in perforations in the kit, are always visible and within easy reach. The inside-out construction was suggested by employees of the Murray Corporation of Detroit, Mich.

7667 Drive for "Flea-Power" Motor Reverses Self in Jiffy

For motors of the "flea-power" class, not exceeding one-fifteenth horsepower, a variable speed drive transmission has been



Unit designed for motors of fractional horsepower

54 *Graham Transmission, Inc.*
2706 N. Dentonia Ave.
Milwaukee, Wis.

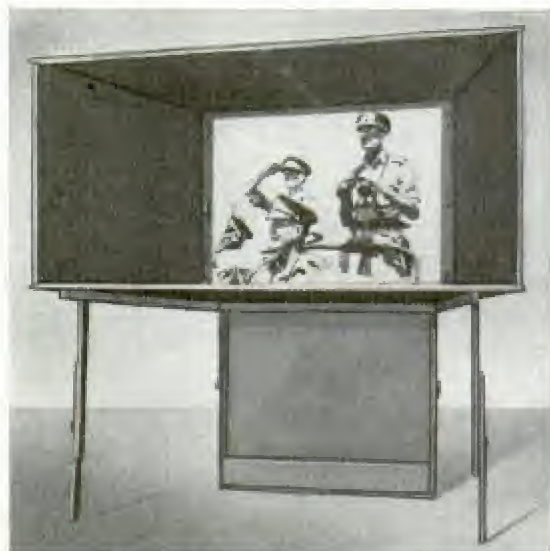
developed which can be reversed without reversing the motor. The unit, complete with motor, weighs only eight pounds. The input shaft turns at 3,600 r.p.m., and has an output speed from 700 r.p.m. to zero. The reversal is said to be instantaneous and shockless while the speed is maintained at a constant level. Speed is controlled by a hand wheel or lever.

7662 Chemical "Overcoat" for Zinc Releases Essential Chromium

Zinc and cadmium surfaces are protected with a new anti-corrosive chemical, releasing much essential chromium for military purposes. The chemical, developed by the Rheem Research Products Laboratories in Baltimore, forms a thin coating which is not injured by bending or twisting. Articles dipped in the solution take on an olive drab color. Tests conducted by army engineers show that the coating affords protection against salt spray and humidity at high temperatures.

7676 Films Shown in Broad Daylight On Hooded Projection Screen

Clear pictures in daylight, with the windows of the audience room wide open for ventilation, if desired, are possible with the



Clear pictures may be seen in daylight on this screen

use of a daytime projection screen. A normal audience of 125 to 150 can view the screen, which is portable, readily set up, and adjustable to four heights. Such daytime screens are used to train military classes and to teach civilian workers. Their use is said to eliminate drowsiness and lack of attention that results from showing films in darkened rooms, with windows so heavily curtained that ventilation is poor.

POPULAR MECHANICS

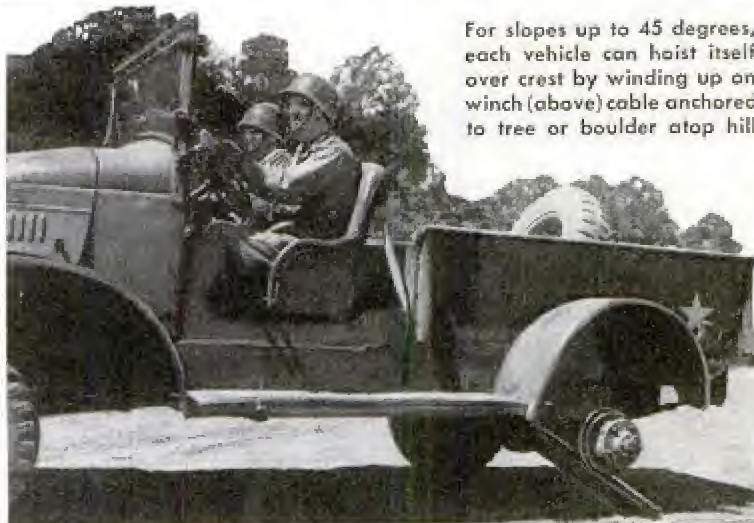
Radiant Mfg. Corp.
1140 N. Superior St.
Chicago, Ill.

*W. D. Tardy, Capt. A. D. S. Director, Tank Destroyer School,
Publications, Camp Shab, Tex 7593*

It's "Up and Over" With the Tank Destroyers



To the men of the Tank Destroyers, there are no insurmountable obstacles. Using only the tools they carry, together with those accessories likely to be found in the field, they are prepared to demonstrate mobile warfare—with a capital "M." Above, vehicle in simulated shell crater gets a lift from an "A frame." Stout timbers, lashed at one end are leaned astraddle the bumper of stalled vehicle. A chain or cable runs from bumper over apex of "A" to winch on a second vehicle. When winch pulls the "A frame" to vertical position, it also raises stalled vehicle out of pit. Right, with wheel blown off, log supports rear end



For slopes up to 45 degrees, each vehicle can hoist itself over crest by winding up on winch (above) cable anchored to tree or boulder atop hill



Jeeps are converted into a variety of "trolley car" to bridge a stream. Dismounted troops cross and hold opposite bank, while a 10-ton wrecker backs to high spot on bank, where its big cable is unwound, and snaked across river and fastened. Two snatch blocks are put on slack cable, and jeep is suspended from them, making an improvised trolley. The wrecker tightens its cable, lifting jeep until the cable runs across stream on a downward slant. Then vehicle is pulled across—and when wheels touch opposite bank, it drives away

Signal Corps photos

WINGED LIGHTNING



Ordnance crew servicing P-38's nose artillery—four .50-caliber machine guns and one cannon

MORE people in foreign lands have seen America's twin-tailed fighter plane than have Americans at home. Practically every new P-38 is flown or shipped to a theater of operation as soon as it gets its factory flight check.

Back from the fighting fronts are coming some remarkable stories about this two-motored fighter. In the South Seas a P-38 pilot flew his rugged plane into a Zero and right through it, scattering the Jap all over the sky, then returned to his base with only minor damage. In the same area another P-38 pilot after exhausting his ammunition deliberately used one of his propellers to saw the tail off a

Zero. In fact, quick-eyed young American pilots gravely discuss the best way to use one propeller as a weapon in plane-to-plane combat,



Left, loading camera substituted for gun in practice maneuvers. The film from camera gun shows "hits"

knowing that they can get back to base on the other engine.

In Africa when the pilot of a P-38 returned to his field with the tips of one propeller bent back and that engine shut down he explained that he had flown so low in strafing an enemy motor column that he had unintentionally dug one propeller into the ground. During that same campaign another pilot hit a telephone pole at such an angle that his plane flipped over on its back and went hurtling along upside down only a few feet off the ground. The pilot cautiously pushed his control wheel forward to "dive" the plane upward and gain some altitude, then

In high-altitude regalia, complete with oxygen mask and goggles, pilot is ready for takeoff. Below, P-38s in formation



rolled right side up again and returned home.

Although the P-38 Lockheed Lightning was designed to operate at 35,000 feet or higher, it has also made a name for itself as a fighter at tree-top height. It was designed as a pursuit and interceptor, yet on occasion it is now used as a tactical bomber and can carry a surprising bomb-weight under its wings. Even today its maximum top speed hasn't been published aside from the statement that during a dive the airplane enters the air compressibility range before it

Pilot's armament includes personal revolver, two demolition bombs, fragmentation bombs, cannon, and the four machine guns





Ordnance officer inspecting gun controls in P-38 cockpit. Button on arm of wheel fires 20-mm. cannon; button on back of wheel fires machine guns

attains maximum velocity. One report is that a P-38 was dived at such a terrific speed that the leading edge of its wing was caved in by the pressure of the air.

This plane is so fast that from the ground the roar of its engines seems to come from half a mile or more behind it. At high speed its wing tips cut vapor trails in the atmosphere in making turns. Bullets from the plane's machine guns behave differently than when fired from a stationary point on the ground because their speed is the sum of their own muzzle velocity plus 65 percent of the plane's speed. The guns are sighted-in for flat trajectories.

Ordinarily an automatic cannon shoots out a long thin muzzle blast of flame when it is fired. On the P-38 this muzzle blast is compressed into a fat egg-shaped flame because of the plane's forward speed.

You don't climb into the cockpit of a P-38, rev up the engines, and take off the way you would in a basic trainer. This fighting plane is far more complicated and to fly it you must have a dozen times the knowledge, say, of a pilot of the first World War.

To begin with, even if you are inside a closed cockpit, you are bundled up so that not a square inch of your body is exposed. For a high altitude mission you wear a

Pilot climbs into plane dressed for sub-stratosphere where temperatures drop to 70 below zero and thin air lacks oxygen

fur jacket, trousers, boots, and gloves in addition to your flying suit. Over all this goes your Mae West life jacket and over that your parachute. You put on a leather helmet with self-contained earphones and throat mike for the radio, and you wear rubber-padded goggles and an oxygen mask. Strapped to your leg is a bail-out oxygen cylinder that you will connect to your face mask if you must leave the plane at high altitude.

There is a double purpose in covering yourself so completely. You need such protection against the cold at high altitude in spite of the cockpit heater. And you need to

be completely covered if you are going into combat at any altitude. If an incendiary bullet should start a cockpit fire, your covering will protect you during the time you need to struggle free and escape from the plane.

Wearing all this gear, you just fit snugly into the seat. You are comfortable even though there's not much room for shifting around. The cockpit is so completely filled



with instruments and equipment that small mirrors are fitted into the corners to permit you to read some of the dials on the instrument board.

You plug in your throat mike and earphones, hook on to the plane's oxygen supply, and adjust your seat belt. Now you throw the plane's master electric switch, turn on the radio, and push the button for today's secret radio frequency. You open the fuel tank valves, turn on the booster pumps that fill the fuel lines, check the mixture controls and propeller governor settings, then prime the engines with straight shots of gas. The engines have been kept warm by the ground crew and you start them by winding up the inertia starters with the plane's batteries. You come back on the throttles to check plugs and magnetos, you glance at the fuel gauges, release the brakes, and move out to the runway.

There is still a lot to do before you begin your accelerated takeoff. When you get your okay from your flight leader or from the tower you roll forward a couple of feet to straighten your nose wheel, then pump up the brakes to hold the plane down while you run up the engines to the point where the superchargers cut in. In a sense you



Student pilot gets a "piggy-back" ride in one-man P-38. The students are squeezed in for demonstration flights on the plane's radio shelf

are building up flying speed while standing still, enabling the plane to hurl itself forward like a rocket the instant you release the brakes. But first there are still a few final chores to do. You check both sets of engine instruments, the settings of the control surface trim tabs, roll up the window and make sure that the cockpit hatch lock is secure, that the fuel pumps are on, and that the fuel valves are turned to the takeoff tank positions.

All this sounds like half an hour's work but you have learned to do it in much less time than it takes to describe. It takes

no more than a couple of minutes from the time the alarm siren sounds for you to be in the air.

The plane jumps toward the sky like a scared jackrabbit when you pull it off the runway. While close to the ground you realize that you are literally strapped to nothing more than the howling engines. At higher altitudes rough air jars as if you were riding a speed boat. In sharp turns you black out momentarily.

To speed up their education an instructor takes student pilots on "piggy

(Continued to page 154)



These pressed metal shells will be joined to form auxiliary gas tanks for the long range P-38s

Model Power Boats Race in Wartime London



A popular stay-at-home sport for war-weary Londoners is model boat racing on the pond in Victoria Park. The fans yell themselves hoarse as the tiny craft flash over finish lines in races timed to the hundredth part of a second. Competitor (above) easing his model steamboat into the water is master of a Thames tug of which his boat is a replica. The fancy craft getting all the attention (left) is a model of the Royal Sovereign, a pleasure steamer frequented by thousands on peacetime holidays. Here pressure is being pumped into boat which runs on flash steam. Below, a model owner wades in to stop his speeding boat. Tiny engines run up to 20,000 revolutions a minute as they whip over pond

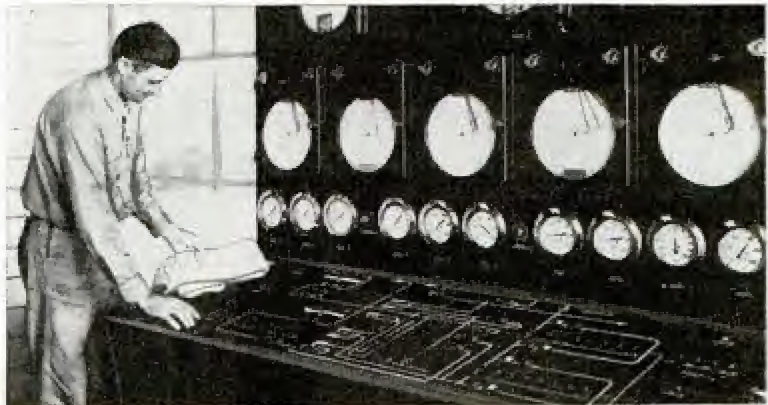
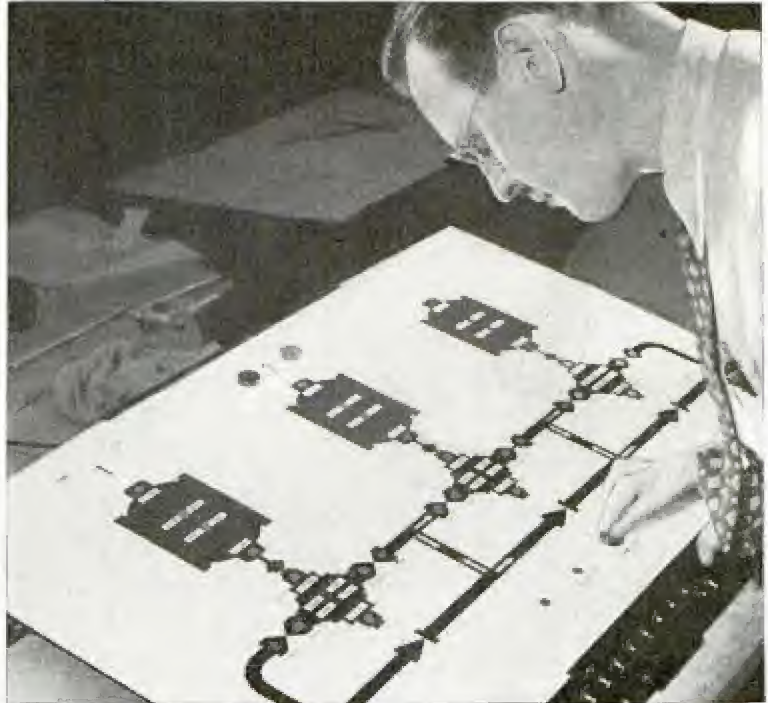


*Model Power Boat Association
Victoria Park, Hackney,
London, England*

Electrical "Nurse" for Pipeline Guards Pumps

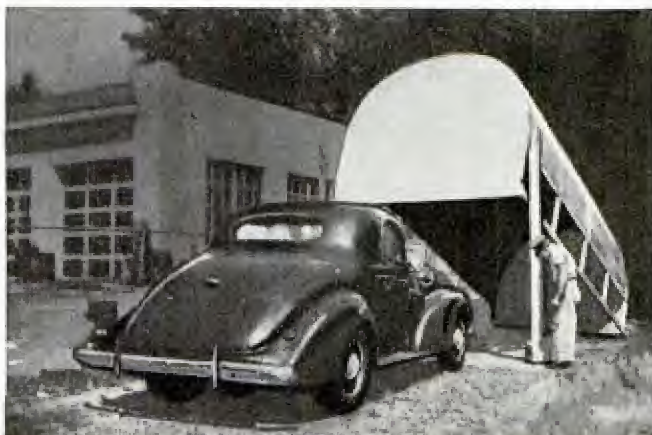
One glance at the control desk at pumping stations along a 1,700-mile pipeline stretching from Texas to the East Coast shows the operator what valves are open or closed. The electrical "nurse," built by Westinghouse, also takes the temperature of motors, pumps and bearings and feels the "pulse," or pressure, in the pipe. The top of the control desk is made of semi-transparent plastic with illuminated arrows on the station diagram showing the route of the oil. If a pump gets hot or develops abnormal temperature, a tiny red bulb flashes on to show the trouble spot on the diagram. Automatic controls stop the electric motor operating the overheated pump, close valves leading into the pump, cause other valves to open and re-route the oil around the idle unit. Under the plastic desk top are some 60 pea-sized lamps, green, amber or red, connected with valves, thermometers and pressure gages.

Colored lights flash danger signals on the control desk of pipeline pumping station



71646

Portable Garage Without Doors Lifts for a Car to Enter



Adjusting the weights for tilting up one end of the garage

Covered with sheet metal or oilcloth with a wire backing, a prefabricated portable garage is designed without doors. To permit entrance and exit of automobiles, one end of the garage is tilted up by weights and pulleys. The structure, which is 18 by eight feet, is anchored to two wooden posts and requires only four concrete blocks for a foundation. The framework is of laminated wood. Easily erected with a small wrench and screw driver, it can also be used as a summer cottage, according to James D. France, Montclair, N. J., who recently was granted a patent on the invention.

26 Orange Rd.

Mr. Alfred O'Neil
5/124 1/2 de Longue Ave. Hollywood, Calif.

SHOUTING with the FINGERS

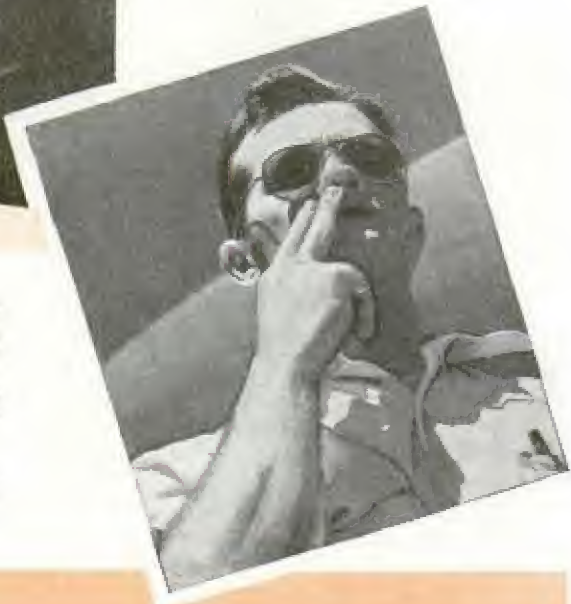


Because man can't outshout the roar of an airplane motor, a new language of signs has grown up along the flight ramps. Nobody knows how it got started, but it is fairly well standardized now and even boasts a special series of "handies" for a ship with de-icers. The man standing before the plane at left, for example, is signaling "raise the fuel pressure." This is done with a clenched right fist and left hand, palm down and lower, parallel with the ground. It's easy on the voice

The masterpiece of pantomime (right) with two fingers held close to the mouth as in smoking indicates motor is smoking

Most murderous gesture of the 30 in general use is the one at lower right. Throat-cutting motion means "cut your engines"

Man (below) with a finger in his mouth and holding up another is signaling "de-icing sequence No. 1 working O.K."





Palms up, used for the bombers, means "Hey, bud, raise the bomb bay doors." Below, too lean a fuel mixture is indicated by fingers pointing to corners of eyes

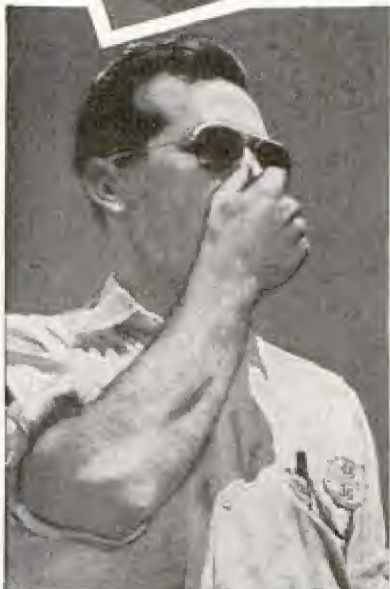


"Lower the oil pressure and be quick about it," is the message conveyed by circle made with fingers

Man holding nose (bottom left) is telling crew mate mixture is too lean and smells none too fragrant

The "A" made with fingers (bottom at center) indicates the auto pilot hydraulic pressure adjustment

Below right, gripping right forefinger in the left fist means "hurry up and pull out that battery plug"



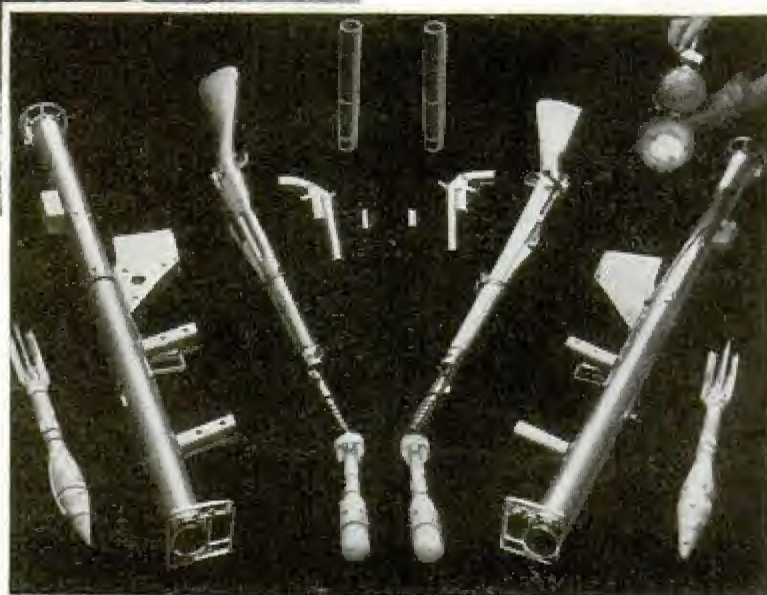
Battery in "Bazooka" Sets Off Rocket Charge



While Nazi propagandists were bragging about secret weapons that never materialized, the U. S. Army produced the rocket gun known as the "bazooka." It has the wallop of a 155-mm. cannon. The guard on the front of the gun (left) is used to protect the operator from flying particles as rocket projectile leaves the barrel. Soldier, below, is demonstrating the right technique in holding the gun. The metal tube is about 50 inches long and less than three inches in diameter. A battery sets off gun's propelling charge



Two-man bazooka team (left) will be ready for action when rocket, which resembles small aircraft bomb, is placed in tube. Attached to the tube are a shoulder stock and front and rear grips for the firer, together with sights and the battery. When the launcher trigger is squeezed, the battery sets off charge. The rocket is about two feet in length and is composed of an explosive head, tube for the propelling charge and finned tail. It pierces tank armor



U. S. Signal Corps photos
Display of weapons (right) flanked by the tank-smashing bazooka shows comparative size. Next to it is the rifle grenade launcher. Other arms shown include the Very pistol and flare launcher. A great advantage of the bazooka in tank warfare is its light weight, making it an ideal weapon in places inaccessible to the big anti-tank guns. One bazooka team captured six Nazi tanks

Lt. Col. Plangford Parmenter, Chief
Publications Branch, War Dept.
Washington 25, D.C.

Theodolite Checks the Air Speed on Test Flight

Test flight engineers at North American Aviation use a theodolite to check air speed on their newest warplanes. The instrument is little more than a viewing frame for following a moving plane, and it is equipped with a pencil and graph paper. The observer studies a plane through a telescope lens and follows it as it flies back and forth over the field at a given altitude. A solenoid switch in the theodolite breaks the circuit every one-quarter second, deflecting the pencil upward for time interval measurement. The pilot flies at several different air speeds, all of which are recorded on the graph. The air speed calibration is obtained from the temperature at the height of the plane, plus the height data on the graph and the air speed meter reading of the plane. Gauging the height on the graph also serves to check the pilot's altimeter.

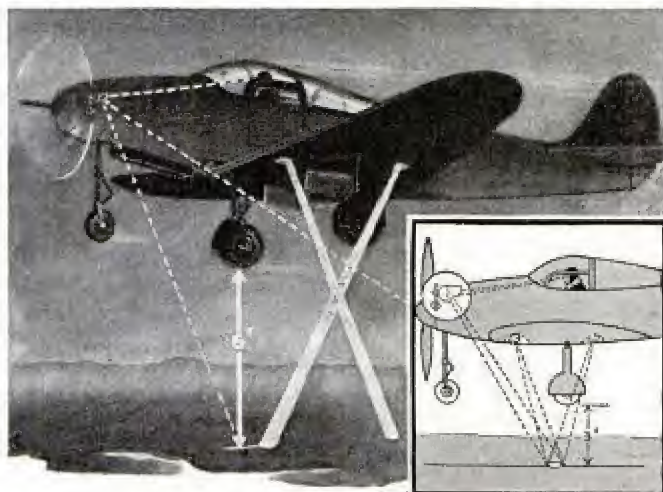
As engineer follows speeding plane through telescopic lens, time intervals are recorded on graph paper



Mirrored Light Reveals Landing Plane's Altitude to Pilot

For night landings, especially on a blacked-out airfield where the danger of misjudging altitude might cause an accident, a simple arrangement of wing lights and a mirror may be used as a rough "altimeter," according to a recently issued patent. Embedded in the wing as close to the

horizontal axis as possible, the lights throw pencil beams downward. Beams can be so fixed that when the plane reaches the altitude of about 6 feet, 10 inches, a mirror mounted on the cowlings reflects two spots of light from the ground into the pilot's line of vision. As the plane descends farther, the spots merge into one another, and become a single spot when the plane is about three feet off the ground. The merging dots tell the pilot how far his wheels are above the landing strip.

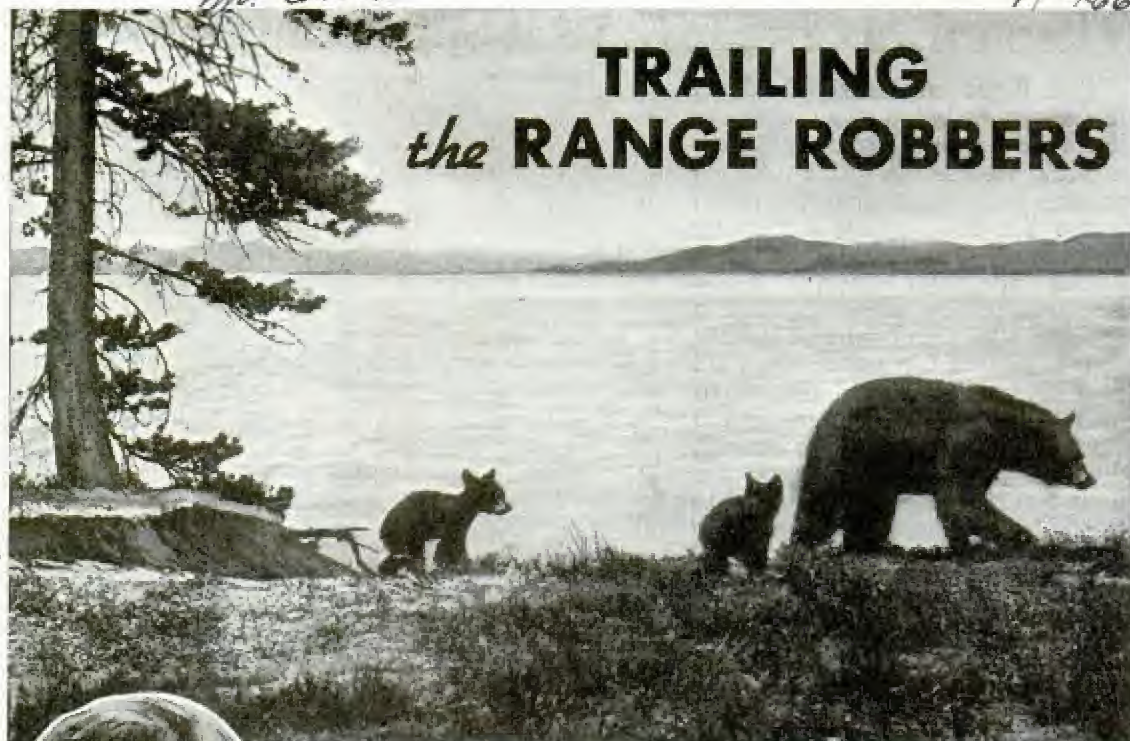


As light dots merge in nose mirror, pilot lets the plane down

Cream for "Flash Burns" Protects Navy Gunners

"Flash burns" inflicted on gunners by the terrific heat accompanying the explosion of a big gun are prevented with a special skin cream developed by the Navy. The cream is applied to face, neck, forearms, and hands. An ounce and a half is said to afford one man complete protection against heat of 1,000 degrees Centigrade.

TRAILING the RANGE ROBBERS



Predators, animals that destroy crops and flocks, like bears, above, and wolves (cub at left) are controlled by U. S. government

and all the other carnivores that prey upon stock, poultry, game and crops. The word is predator.

In the words of Dorr D. Green, chief of the division of predator and rodent control of the Fish and Wildlife Service:

"Any outdoors man is interested in preserving wild life. But mankind has a place in nature's economy too. And since man has come to stay, he's got to be protected against the animals that threaten his livelihood."

Thus, in the spirit of protection and control, the government established the check on predators 28 years ago. It isn't anything new; wolf-bounty laws go back to 1630.

Timber wolves have become a lesser menace, but coyotes, like other predators, actually seem to thrive alongside of man, in part on things that man brings—

chiefly his flocks. Coyotes have spread east of the Mississippi, probably through the stupidity of tourists who brought whelps home, and set them free when the pups became grown.

A total of 111,076 coyotes had to be destroyed last year. Chief reason is that, depending on the season, up to 18 percent of a coyote's normal diet is sheep.

TO THE visitor from the East, the coyote's yap has a romantic sound. "Takes you back to the old frontier days," the visitor says. "The wild and woolly west."

But to the stockman, the shepherd, the poultry farmer, the hunter of the Fish and Wildlife Service of the Department of the Interior, it isn't so romantic. To all of them, just one word describes the coyote



Porcupines, snowbound in trees, girdle and kill them

Other predators trapped, shot, or poisoned included 10,957 lynx and bobcat, 791 wolves, 639 bears, and 204 mountain lions. The total of 123,667 predators is completely apart from the tens of thousands of ground squirrels, prairie dogs, pocket gophers, moles, meadow and pine mice and common house mice and rats killed under the program of rodent control.

Control does not mean extermination. Often, a hunter may be sent out to get one particular animal. Thus, bears are not commonly predators—defining as a predatory animal the one that “conflicts most dangerously with the interests of man.” But when a late spring frost kills the berry crop that would otherwise satisfy the bear, he will turn predator, and become a wanton killer, too, slashing down from 20 to 50 sheep in a flock at one time, just out of sheer blood lust. Trapping a single bear often ends the slaughter in a whole neighborhood.

Eliminating predatory animals is a matter of dollars and cents. In areas where there is no predator control, losses to sheep flocks run as high as 20 percent, compared with about 5 percent under control. The controls now in effect save some 3,700,000 sheep and lambs a year, saving their meat and wool.

Control of the carnivores is the romantic side of the story, but it should not eclipse the rodent program. Rats every



Mountain lions (above) are holding their own; about 200 to 300 have to be destroyed each year because of their taste for lamb. Below, setting loop of snare





Above, a rat-infested corn crib treated by predator controllers

year destroy food, feed, cloth and poultry valued at an estimated \$189,000,000. Before rat-control work on a Galveston pier, half of the 84,000 sacks of flour stored there were being fouled or damaged. Afterward, only two sacks were destroyed.

Ground squirrels ruin feed and forage. After a three-year battle with these pests on an area in the Caribou National Forest in Idaho, half again as many head of stock could be fed on the range as before the control began.

In numerous orchards of the northeast, as many as three trees out of four are girdled by pine mice below ground or meadow mice above. Porcupines, too, aren't always the quaint, humorous characters of the kiddies' story books. In Arizona, one estimate was that 27 percent of the trees suitable for timber needed urgent porcupine con-

trol. Porky gets stranded by snow in the upper branches of jackpines, and to while away the long days—as well as to content his stomach—he girdles the branches and boles of the tree, and in numerous instances kills young plantation pine trees as well as natural-reproduction stock.

Predator and rodent control is a co-operative procedure. A state, county, a stockman's association, a farming group, or an individual generally puts up about two-thirds of the cost of a control program, and federal funds supply the other third.

"When control has been attained in a locality to the degree that depredations of predators or rodents are no longer acute, financial co-operation is reduced accordingly," the Fish and Wildlife Service points out.

Though mountain lions, or cougars, are easily the most glamorous of the predators, fewer lions are taken than almost any other pest. The lion likes venison on his table. It's only occasionally that he'll stalk sheep or calves—though he relishes a young colt. Cougars are holding their own. They are

taken chiefly in the Southwest, a steady 200 to 300 every year. Sometimes a really bad cougar shows up, like the one in Idaho that destroyed \$700 worth of lambs from flocks grazing within a radius of 15 miles.

The 11 Western states all harbor predators of one sort or another. Over their 761 million acres, coyotes and rodents particularly revel in spoils. But their 37,000,000



Left, prairie dog, the western pest. Below, setting traps for coyote, No. 1 predator. Bottle holds luring scent



Rifle Range Ranch
40 miles south of
Butter Creek, Wyoming

POPULAR MECHANICS

sheep and lambs—75 percent of the nation's total—are vital for meat and wool.

A Colorado rancher recently lost 40 lambs in two weeks to a crippled coyote, seeking easy game. An Arizona rancher lost 15 percent of his sheep during a drive of 25 miles. Nevada ranchers reported losses of up to 35 percent of their lambs from a band of 5,000 sheep.

Hunters and sportsmen have a prime interest in controlling predators. During one year, by Forest Service estimates, predators destroyed 129,152 big game animals on the national forests alone. In Los Padres National Forest in California, coyote predation was called a major threat to deer herds. Ground squirrels, destroying food and cover, also make life difficult for game birds.

Trapping, hunting with guns and dogs, and poisoning are the chief methods of eliminating predators. In the Old West, ranchers would faithfully drop poison in every carcass found on the range, in hope of destroying a coyote returning to his kill. Such indiscriminate use of poison has been roundly condemned, because of its threat to game and fur animals. The Fish and Wildlife Service urges that poison be set out only under expert supervision.

Coyotes are also controlled by denning and trapping. An experienced hunter tracks the parent coyote back from its kill or its waterhole. Between April 5 and June 15 whelps may usually be found in the dens, and the parents often can also be caught with traps.

Trappers go to elaborate lengths to remove all "man smell" from the trap and set. The trap may be buried in an old manure heap, as is the "setting cloth," a square of canvas on which the hunter kneels while preparing the set. A scent attractive to coyotes—and bobcats as well—is made of ground up fish that has been permitted to putrefy. This is sprinkled on a stick or piece of brush near the set.

Bobcat depredations in parts of Arkansas in recent years have made hog-raising impracticable. Bobcats also raid sheep herds, especially during lambing season, killing the lamb with a characteristic vicious bite on the back of the neck or head. A single bobcat has been known to kill 38 lambs in one night, in a feline spirit of wanton slaughter.

Romantic animals, these carnivores, providing a living link back to the colonial days when America was wilderness. Remembering the bison, no lover of the American tradition would want them destroyed. The Fish and Wildlife Service holds that only by expert control can the predators be kept in their proper wilderness niche, if man is to get a break too.

JANUARY, 1944

Glass Made Non-Reflecting By Secret War Chemical



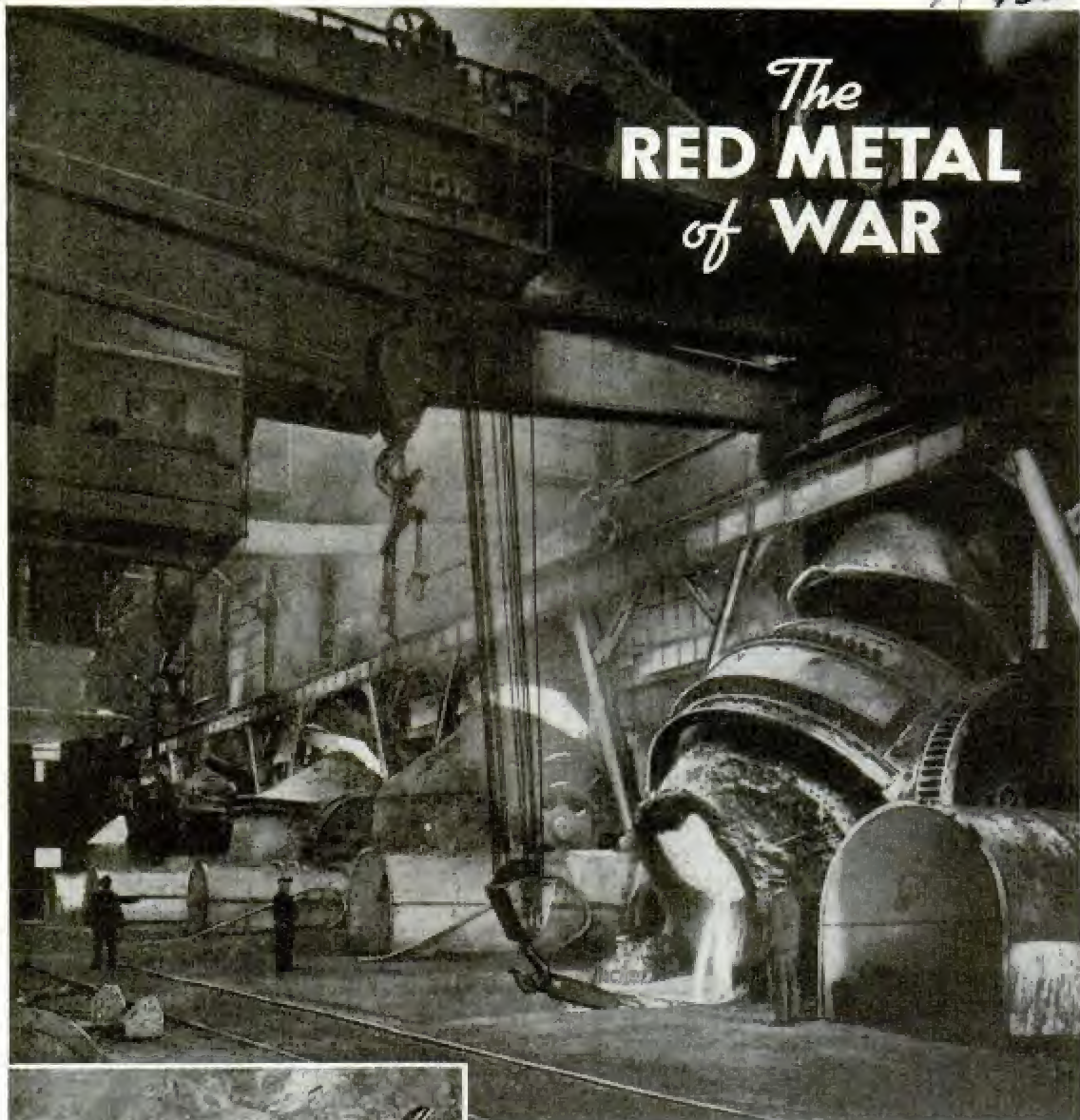
Subject above is photographed through a glass panel whose left half was made chemically non-reflecting

Ordinary glass transmits about 92 percent of light, the remaining 8 percent being lost through surface reflections. Much of this "lost" light is saved by the use of a surfacing treatment, whose chemical composition and method of application are now secret because of their military applications. The technique permits the making of large areas of glass and other light-reflecting materials nonreflecting. In post-war applications, auto accidents could be lessened by surfacing windshields to reduce light reflections that blind the driver. Spectacle lenses would become less conspicuous; show windows and cases would display their contents without distracting reflections; pictures, framed or unframed, would show to better advantage; camera lenses would produce better pictures if treated. Even the glare from the faces of clocks and watches could be reduced.

Names and addresses of makers or sellers of commercial products described in this magazine are listed in the Where-to-Buy-It index, page 4A. Write to them for additional information and be sure to Say You Saw It in Popular Mechanics.

American Optical Co.
Southbridge, Mass. 69

The RED METAL of WAR



Copper and Brass Research Association

Pouring from giant converters is molten copper, a precious war metal. Left, copper miner drilling holes for blasting

WHEN the 300 odd pieces of sheet copper were riveted together in New York harbor nearly 60 years ago to form the Statue of Liberty, little was it supposed that the same red metal one day would become of immeasurable value in a battle to uphold the ideals for which the giant figure stands.

Yet that is just what has happened. Because of its primary importance in war production, copper now ranks with steel and aluminum at the top of the list of essential war materials. And because of the tremendous wartime demand, copper has taken its place as one of the world's truly precious metals. Silver frequently is used as a substitute for copper in war products.

With its closely related alloys, brass and bronze, copper is indispensable in practically the entire range of fighting equipment. It is used in

munitions and guns of all types, in planes, tanks, ships, for all communication facilities, in buildings and camps, and in machine tools and other production equipment. Two and one-half miles of copper wire are used in a bomber in addition to other copper parts that sometimes account for one-tenth or more of the plane's total weight. Two million pounds of copper are used in a battleship, 800 pounds in a tank.

The United States is the world's largest producer of copper, and output is being pushed to the limit. The red metal is being imported from South America in quantities that tax shipping facilities. Latest figures place the available supply at more than 2,500,000 tons. Every effort is being made to conserve the metal, to find substitutes, to collect copper scrap. Civilian consumption has been cut to the bone.

But in spite of all these things, the military demand alone is estimated at 8 percent more than the supply. When absolutely necessary civilian needs are considered, the excess of demand over supply is reported to be about 25 percent.

Copper conservation measures and substitutes have gone a long way toward stretching the copper supply. The red metal has been placed at the top of the list in all scrap collection drives, and substitutes include glass, plastics, iron and steel, porcelain enamel, gold, silver, Bakelite, zinc and wood.

Time was when milady's lipstick case was copper; now it is plastic, silver, gold, wood or paper. Giant bronze castings have given way in many instances to steel, iron or cadmium-base die

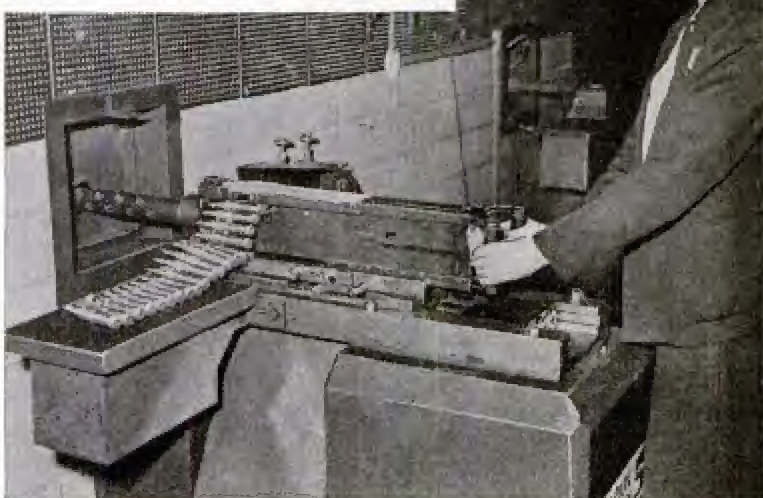


There's a lot of copper in those .50-caliber cartridges (above). Munitions industry is the largest single user



Left, nose plugs in the 500-pound "Bundles for Berlin" contain copper. Here plugs in bombs are being tightened

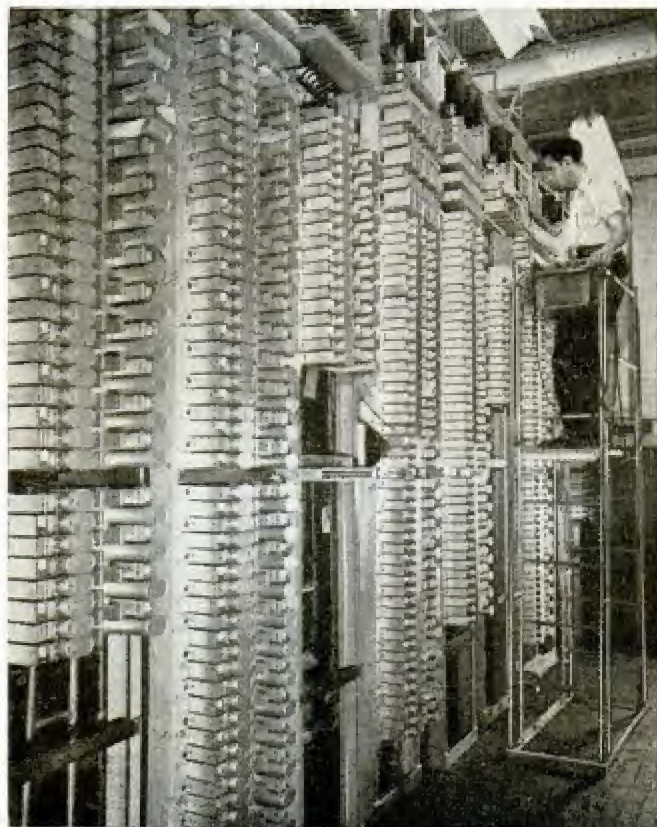
Below, woman "machine gunner" firing test round of .50-caliber cartridges in proof house of an ordnance plant





Westinghouse photo

This "torture rack" determines amount of "creep" in molecules of copper bar under stress. Below, "carrier" telephones save copper by sending as many as 16 messages over a single wire



castings, and even lead. Even dog tags used to be copper, but the tags you see today are likely to be plastic. In many instances—electric light bulb bases, for example—a core of steel is used with only a plating of brass instead of solid brass.

Some of the substitution measures have brought startling results.

Elimination of the brass in ferules that hold lead pencil erasers, it is reported, saved enough metal to make about 13,000,000 brass cartridge cases, and elimination of brass in shoe eyelets has provided material for 1,000,000 shell cases.

In Detroit, the Edison Company devised a method of straight-line home wiring that saved an average of four pounds of copper on each of 11,000 homes built in the last two years. Plastic printing plates have grown in favor, and a recent study by the War Production Board showed that a considerable amount of electrolytic copper may be saved by the use of such plates which are said to be satisfactory for up to 50,000 impressions.

By eliminating unnecessary frills in scores of articles from hairpins to industrial power trucks, manufacturers in 1942 saved 1,700 tons of copper, according to the WPB. Simplification orders affected more than 300 products. For example, sizes or types of valves and fittings have been reduced from 4,030 to 2,500; electric light bulbs from 3,500 to 1,700; heavy forged hand tools, from 1,150 to 357; water coolers from 27 to 8; auto storage battery types from 100 to 16; fluorescent lighting fixtures from 200 to 2.

Even the nation's money has felt the copper pinch. New copperless pennies are in circulation, as are new five-cent pieces with 25 percent less copper than formerly. The wartime pennies are made of zinc coated steel, taking the place of the old pennies which were 95 percent copper. Last year, 4,600 tons of copper were used in minting pennies.

The new "nickels" are 35 percent silver, 56 percent copper and 9 percent manganese. Formerly they were 75 percent copper and 25 percent nickel. We have, thus, a nickelless nickel, containing far less copper, and releasing large

Yanks in Iceland help conserve metal by packing all the empty shells after they have been fired



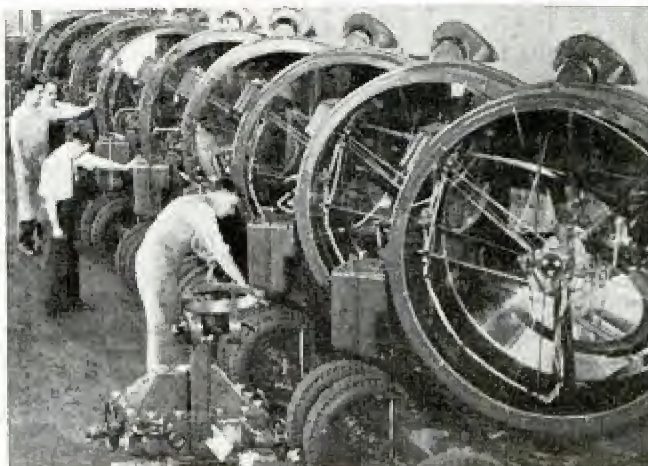
quantities of both nickel and copper for war production.

Because of its high conductivity, copper is the foundation upon which the electrical and communications industries are built, and in these fields the red metal is one of the most difficult to replace. To a large extent, there is no commercially accepted substitute for its current-carrying uses.

A large percentage of all the copper used goes into these two industries. Although not as ductile as silver or gold, a copper billet 4 by 4 by 53 inches will draw into a 2,500-mile strand of 42-gage wire. But in only four minutes, a machine gun will consume some 30 pounds of copper in bullets, enough for a mile and a half of telephone wire.

The modern steam locomotive contains some 8,000 pounds of copper, but an electric locomotive may employ as much as 75,000 pounds. Large steamships and naval vessels contain much copper; 3,000,000 pounds of the red metal, for example, were used in building the Queen Mary. Since modern war equipment is largely mechanical, the demand for copper for tanks, trucks and other automotive type equipment may be gaged by the fact that in peacetime the automotive industry was the second largest user of copper in the world.

Probably the largest single use of copper



Reflectors in giant anti-aircraft searchlights contain copper

in war production is in small-arms ammunition and artillery shells. It is estimated that 525,000 tons of copper were required for the fabrication of brass sheets for munitions this year. Some large shell cases now are made of steel instead of brass as a result of new methods which save several million pounds of brass every year. (Brass is an alloy of copper and zinc, and bronze is an alloy chiefly of copper and tin).

"Drafting" of U. S. Treasury silver to replace copper is an example of how the red metal has come to be precious. Recently, 17,000 tons of treasury silver were released.

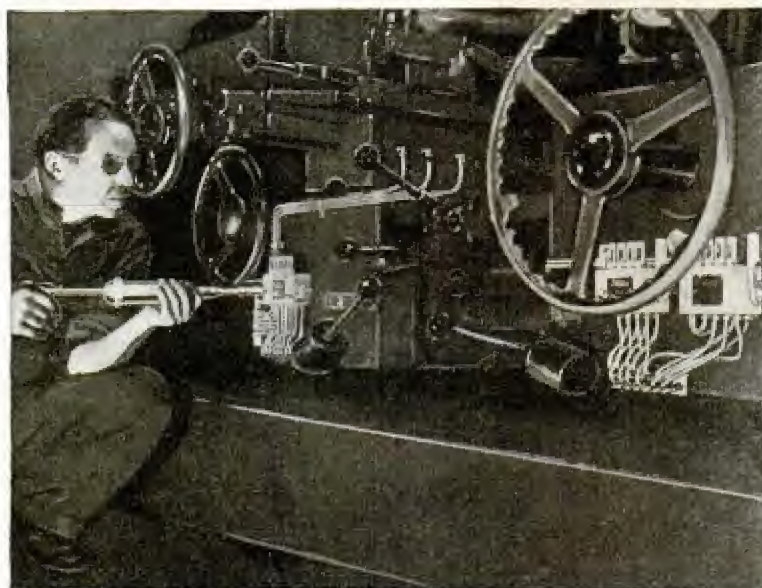
Substitutes of silver for copper are being

(Continued to page 146)

Farnal Corp.
 3249 E. 18th St.
 Cleveland, Ohio

N 600

Remote Control Oil Blocks Lubricate Bearings



Up to 10 bearings are lubricated at one time by multiple valve blocks

Bearings on machine tools and similar equipment may be lubricated, regardless of location, through centrally placed distributing blocks, for which a manual or power-operated portable gun serves as a central pump. Valve blocks each serve from two to 10 bearings, and lubricant lines lead from the blocks to individual lubricating points. A valve handle on the centrally located block directs the flow of the lubricants, either oil or grease, and an indicator on each valve piston indicates the positive delivery of the lubricant.

N 598

'Stinger' in Nose of Liberator Is Two-Gun Electric Turret

Thirteen projectiles a second can be fired from each of the two 50-caliber machine guns mounted in a new electrically operated turret mounted in the nose of Liberator (B-24) bombers. So adaptable is the Emerson turret that it can be installed in either the bomber's nose or tail. Inside it, the gunner has a visibility of almost 360 degrees. He expends little effort in aiming, as an electric motor moves the turret. Without this mechanical "stepping-up," his strength would be insufficient to hold the guns on the target accurately.



Liberator's nose turret can fire 26 projectiles a second from twin guns

N 776

Tuning Fork Tells Examiner When Pilot Is Too Fatigued to Fly Safely

With a modified tuning fork, Maj. Aaron Roth believes he can readily ascertain when a pilot is reaching a dangerous level of fatigue and needs to be temporarily grounded. The fork has a frequency of 128 cycles, and intensity of 70 decibels, and with normal persons its vibrations can be perceived by the fingers for the duration of 35 seconds. In using the "neurometer," as it is called, the examiner strikes the fork, making it vibrate, then places it against the

patient's upturned fingers, noting the exact time. When the patient can no longer feel the vibration, the time is again noted. In general, the vibration sense at the fingers is lessened when the fingers are cold, when they have been strenuously exercised, or in general fatigue.

Compressed air at 3,000 pounds pressure per square inch is used to charge and eject torpedoes from their tubes.

74

Developed by Major Aaron Roth, M. C., U. S. Army. Details reported in War Medicine, military medical journal

POPULAR MECHANICS

5-35 N. Dearborn, Chicago.

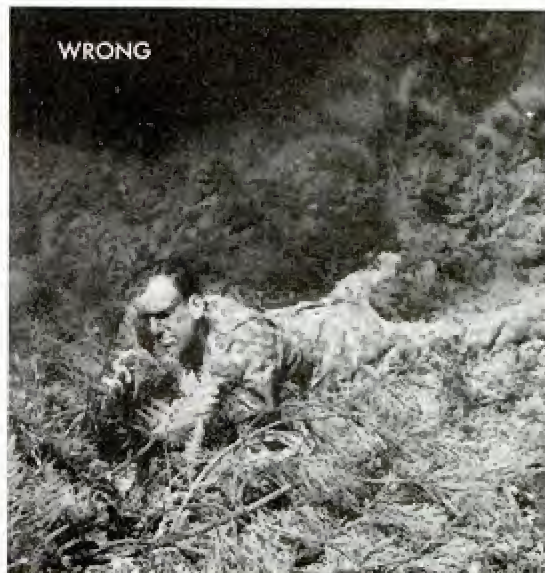
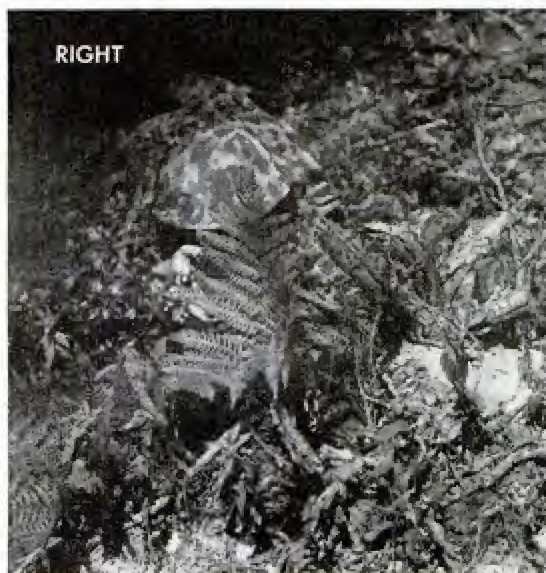
Ford Motor

Cafeteria Style Camouflage Served Up at Camp



Soldier students of camouflage at Camp Edwards, Mass., learn the right and wrong ways to employ this military art at a "camouflage cafeteria." This is an arrangement of exhibits that advance from simple form to the most complicated means of fooling the enemy. Observers are led to the exhibits by wired paths. Above, man at right merely sought partial concealment in ruined building. In the other photo he used materials at hand to blend into the surroundings. From the front view, even the rifle is hard to detect

Just because a fellow is daubed up with green paint is no guarantee that the enemy can't spot him in a jiffy. The man demonstrating faulty camouflage (below) is wearing a suit designed to blend with living foliage and he has taken a position behind some withered brush. His face is smeared, but he has taken off his helmet. Another error is white tape showing on rifle. In the other photo, soldier uses same equipment against a live background of foliage to demonstrate almost perfect concealment. Try and find his gun



GRASSHOPPERS *with* TEETH



C. A. P. pilot taking aim at a stock-killing coyote

TWILIGHT on the Gulf of Mexico had been picked by the skipper of a Nazi U-boat as the time to torpedo another American merchant ship. While he was surfacing for the kill, just one miscalculation marred the plan. As his periscope broke the peaceful waters of the Gulf, a tiny plane—much too small to be so far from shore—swung sharply to challenge

this pink "pig boat." The U-boat crash dived and another American ship with cargo and crew was saved.

More than 150 such episodes are credited to the Civil Air Patrol whose members have officially logged more than 20,000,000 miles of wartime flying. Of course, not all Axis submarines are pink. This one apparently had been prematurely forced from its base with only a coat of red lead which sun and salt water had changed to a sickly pink.

During this year's floods, the patients in an overcrowded hospital fearfully watched rising waters. The building was

located on a slight rise of ground and was temporarily safe—but no one could tell for how long. Crews worked feverishly filling sand bags. Sand was plentiful. Bags were not. Highways were closed to motor traffic, and no flying field was available. Using a small strip of highway that was not yet under water, C.A.P. planes from the Terre Haute, Ind., squadron made 22 flights

Pilot lowering hook to pick up a message on the fly—a handy trick in districts observing radio silence



Streamers are attached to message container tossed overboard

bringing in bags with which the hospital was saved. This flying was done with a visibility of less than one-quarter mile and a ceiling of not quite 400 feet.

Overworked agents of the F. B. I., too, have looked to C. A. P. for help and received it. Saboteurs and other criminals have been speedily brought to book. Hastily summoned by the F. B. I., a courier pilot from Cincinnati flew G-men on the trail of an escaped felon. Hedgehopping to a landing in a small pasture, this pilot unloaded his passengers. Then, circling for observation, he continued his job by assisting in locating the fugitive from the air while the G-men closed in from the ground.

Not all jobs are so spectacular. Night and day and in weather so thick that even birds might choose to walk, constant patrol is maintained along the Mexican border. So, too, is patrol maintained along many miles of our vital oil pipe lines which carry fuel to ports for shipment to war zones.

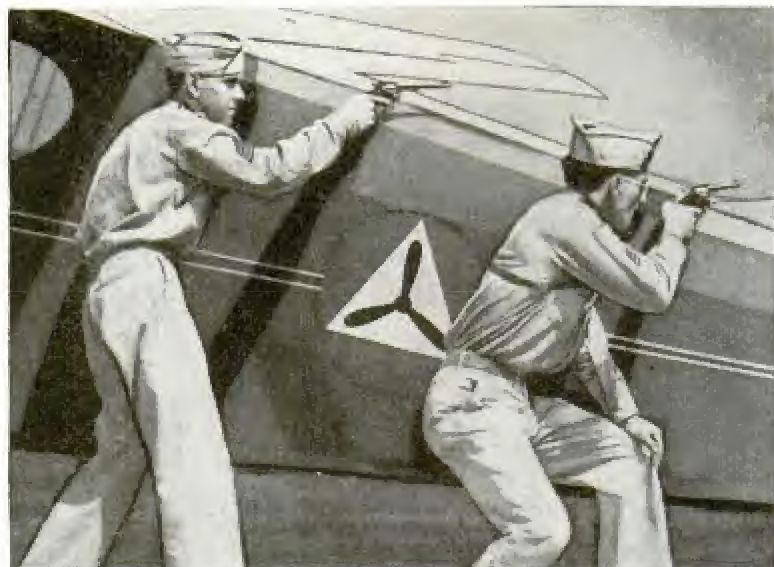
Out West, new techniques for relieving the meat shortage have been developed. With coyotes becoming increasingly bolder

Right, C. A. P. officers demonstrate commando technique. Below, catching message tossed from a plane



and attacking live stock, action was necessary. Flying low over the prairies, many a coyote was flushed. Then the pilot circled to get behind the animal. Turning sharply from right to left to avoid over-running him as he fled, the pilot jockeyed into position where his observer could shoot him down. And since these coyotes bring an eight-dollar bounty, a landing was made, the animal skinned, and the hide brought back. While such flying had its hazards, it was probably the fleas from the coyote that worried the boys most.

Forest fires which threaten our lumber reserves are frequently spotted by C. A. P. patrols. In the vicinity of a fire, visibility



Alert courier pilots are prepared to defend their cargo with small arms

is bad, forced landings deadly dangerous, and air turbulence at its worst. Not only do pilots spot such fires, but by communication with ground forces they direct their activities until the fire is under control.

Towing targets over rookie antiaircraft batteries isn't the safest job in the world. One pilot who has flown countless hours on such duty returned to base one day with only 18 feet of tow line left behind his plane. Miscalculating in some manner, the ground crew had sent a burst too close. The pilot was angry—not for personal reasons—but because the broken line interrupted this training work! With a new target and line he took the air again to fly back and forth while the rookies developed their firing skill.

Of course, not all C. A. P. jobs are flying work. The basic training required of all members takes more than 230 hours, in classroom, field, and air. Part of this work is in communications, and knowledge of code recently enabled an Indiana man and his wife to save an army pilot and his ship. Circling in a blinding snow storm, the pilot was striving vainly to find a field. With the headlights of their car, the C. A. P. couple flashed a message that enabled the pilot to land safely on a nearby farm.

Many C. A. P. units work out elaborate missions between ground members and pilots. With mountain peaks often claiming the lives of fliers, the New Hampshire wing has squadrons whose members include expert skiers. These mountaineers are directed to objectives by their flying partners.

A C. A. P. cavalry unit of the Nevada wing demonstrated the value of ground-air technique. Hearing

Signalman controlling traffic during mass maneuvers—some total over fifty planes

that an army bomber had crashed, the entire C. A. P. organization of the state was called out. The wrecked bomber was soon spotted from the air. As it was impossible to land in the vicinity of the plane, C. A. P. pilots directed their mounted members to the scene. Had there been any survivors, complete medical care could have been provided, for first-aid training is required of every member and the Nevada unit had a fully equipped motorized dispensary.

A war plant in Detroit was recently threatened with a shut-down for want of parts. This particular branch was rushing production on a new weapon. To continue production required picking up certain material in Muncie, Ind., and taking it to Warren, Ohio, for processing. From Warren it had to be carried to Detroit for assembling, and it seemed impossible to get this critically needed material in time. Not only was it provided in time, but the production schedule was actually put five days ahead as a result of C. A. P. courier service.

If you see C. A. P. planes flying near



Army ordnance proving grounds, give them a wide berth. They may be nothing more or less than "flying munition dumps." It is no military secret that samples of munitions are taken constantly to various army arsenals and proving grounds for testing. C. A. P. pilots are called on for this hazardous duty. Though their load may not be large, it is deadly and deserves all the respect due a stick of T.N.T.

Of course, accidents happen. When this was written, 30 C. A. P. members had given their lives and 73 planes had been lost. Flying coastal patrol, carrying munitions, hedge-hopping for coyotes, tracking criminals, transporting blood plasma, serums, and other medical supplies in storm areas can hardly be considered the safest kind of work.

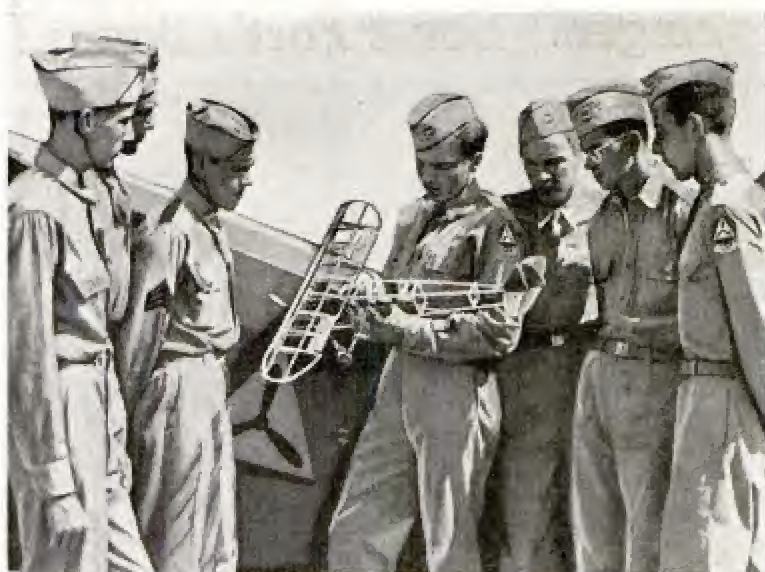
Only Russia and the United States allow civilian flying in wartime. Civilian aviation in Russia has been an important source of pilots for the Russian Air Force. This has been largely true in the United States, too. Long before Pearl Harbor, Earle L. Johnson, now Major Johnson of the Army Air Forces, commanding all 48 wings of the Civil Air Patrol in the United States, saw that our thousands of small planes had

great possibilities for good or evil. To dramatize his fear that these ships might be used for sabotage, he took off in his plane and, with small sand bags, "bombed" a vital defense plant.

Quick action followed. Airports were guarded—private planes grounded. There were 100,000 civilian pilots in this country at that time and about 25,000 light planes. Many of these pilots were soon in the armed forces, but there were others eager to serve as civilian fliers. So, under the Office of Civilian Defense, C. A. P. organized the country into volunteer flights,

(Continued to page 150)

C. A. P. cadets study aircraft controls on a model before leaving ground



Regular members of army antiaircraft unit rigging sleeve target to be towed 1,800 feet behind C. A. P. ship



*Boeing Aircraft Co.
Seattle, Washington*

11 579

"Fingers" Boost Fort's Bomb Load to 10 Tons



Arrows point to one of the two external bomb racks mounted beneath wing of Fortress, increasing bomb load

Forklike fingers extending beneath the wings of the Flying Fortress are external bomb racks, whose use makes the plane a vastly more destructive nemesis of the Axis. For with the external bomb racks,

together with the bombs carried inside the fuselage, the B-17's can now transport a bomb load of about ten tons. The big Boeing craft thus becomes one of the greatest load-carriers now in operation.

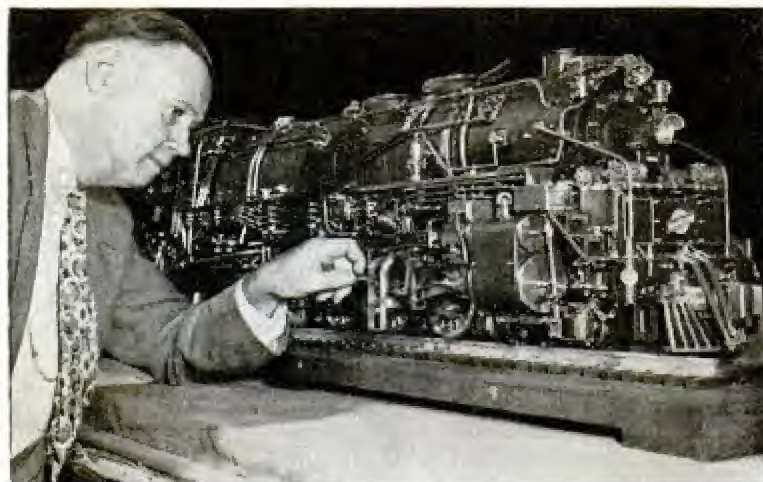
11 573

Working Locomotive Model Took 10,000 Hours to Build

Ten thousand hours of labor, all by hand, went into the making of a working model of a huge Class H freight and passenger locomotive operated by the Chicago and North Western Railway Company. The maker, John F. Lindsey of Chicago, is a chewing gum wrapper by trade, but formerly was a machinist. The model works in every detail, and was made of machine

steel and bronze castings without the use of blueprints. All dimensions were taken from the original engine. It is equipped with a two-cylinder booster engine under the cab, air-operated gear transmission, and is built for 250 pounds of steam pressure. Among the hand-made parts are a superheater, hot water heater, two two-stage air compressors, hot water boiler feed

pump, boiler feed injector, poppet valve throttle, air-operated reverse gear and sander, bell and whistle, turbine-driven electric light generator, air-operated booster throttle, air brakes on all 5-inch drivers, booster and tender wheels, oil pump for cylinders, with leaf springs for all axle boxes. The boiler is built of $\frac{1}{8}$ -inch steel, riveted and welded. So closely was the original engine copied that even the brake shoes are renewable on the hand-made model.



Complete in every working detail is this hand-made model of locomotive

*John F. Lindsey
11448 Longwood Dr.
Chicago, Ill.*

POPULAR MECHANICS

*Ford Change & Rent
Willow Run, Mich.*

N 541

'Sky Hook' Removes Propeller by Tractor Power

When one of the 440-pound, three-bladed propellers of a Liberator bomber at the Ford Willow Run plant must be removed or replaced, a tractor-driven "sky hook" wheels out and does the job on the spot. Formerly, to change a propeller outside the factory, workmen were forced to haul out cumbersome steel platform ladders, and to commandeer a truck to haul the prop to where it was wanted. The new hoist utilizes a stock Ford tractor, and can dash out on the field with tools aboard, run up an 11-by-4 foot platform, lift off the prop and carry it back to the hangar. The prop-hoist works on a hydraulic system. An oil tank is mounted on the rear of the tractor; the hydraulic pump which delivers the pressure is driven from the tractor engine through a standard power take-off shaft in the rear of the engine. The platform and hoists are regu-



Tractor-driven hydraulic hoist removes the propeller and carries it away

lated by valves. The crane may be raised 17 feet 6 inches from the ground, and the working platform, large enough to hold five men, can rise more than 6 feet.

M. Cohen

"Searchray" With an Electronic Eye Inspects Any Parcel

Suspicious packages and luggage can be inspected without danger to the inspector with an anti-sabotage weapon known as "Searchray." It provides instantaneous,

non-destructive, fluoroscopic and radiographic internal examination of packages. It might be used in war plants, to examine incoming and outgoing parcels, luggage and the like, as well as in air and rail express offices, post offices, customs houses and police stations. To operate, it is plugged into a standard power source, the compartment door is opened, the object to be inspected is placed inside. Then the door is closed, and a push on the control button provides an instant view of the internal structure through an eye-level viewer. Safety of the operator is assured by a rayproof, shockproof housing for the cabinet, which occupies less than five feet of floor space.



Routine examination of war worker's lunch box by "Searchray"

Write to the firms listed in the Where-to-Buy-It index, page 4A, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

JANUARY, 1944

*Industrial Electronics Div
North American Philips Co., Inc.
419 Fourth Ave.
N. Y., N. Y.*

71604

Scale Counts Ration Stamps With Adjustable Indicator



Special chart shows exact number of stamps in scoop

Ration stamps are counted in lots up to 5,000 with a direct-reading scale. This time-saver is 400 times faster than hand counting. To operate the scale, a known quantity of stamps is weighed and the indicator on the special chart is set by hand to register the exact number. Repeated lots can be weighed by placing them in the scoop and reading the chart.

71588

Bender With 2-Way Operation Cold-Forms Metal Shapes

Designed especially for aircraft and marine installation is the Di-Acro Bender, which forms intricate shapes in chrome molybdenum, duralumin, and other low-ductile materials. The danger of fracture, and inherent strains that otherwise occur during cold forming, is obviated by allowing for the development of radii at the points of forming. The model incor-



Bender cold-forms metals without danger of fracture

82 O'Neil-Irwin Mfg. Co.
Minneapolis, Minn.

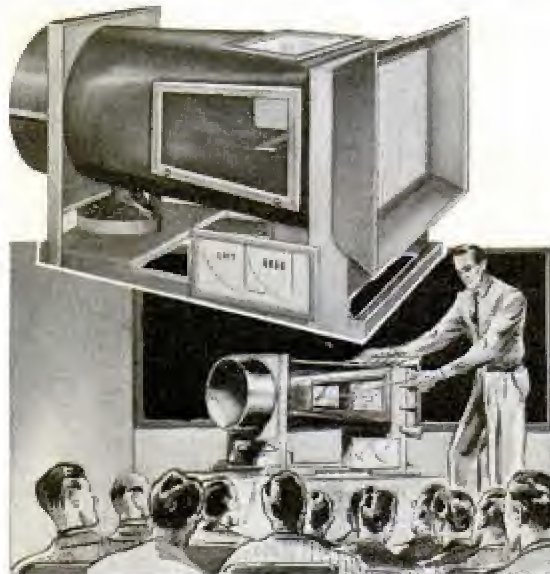
Camel Model Airplane
Supply Co. 129 W. 29th St.
Chicago, Ill.

porates a two-way operating feature that permits the ready reversal of the unit to eliminate interference from conflicting ends of material that may develop during formation of complicated shapes. Its capacity is one-half inch round cold rolled steel bar, formed cold to one-inch radii or larger, with proportionately greater capacity of more ductile materials.

71605

Small Planes "Fly" in Classroom In Midget Wind Tunnel

Similar in design to the great wind tunnels used to test new models of airplanes, a wind tunnel for aviation classes demonstrates the theory of flight. While students watch the effects of airflow through a window in the tunnel, measuring instruments record in ounces the amount of "lift" and "drag" on a model plane. Various experiments may be performed with the tunnel with the aid of airfoils, scale models, drag plates, spheres and streamlined shapes. The



Students observe effects of airflow through window

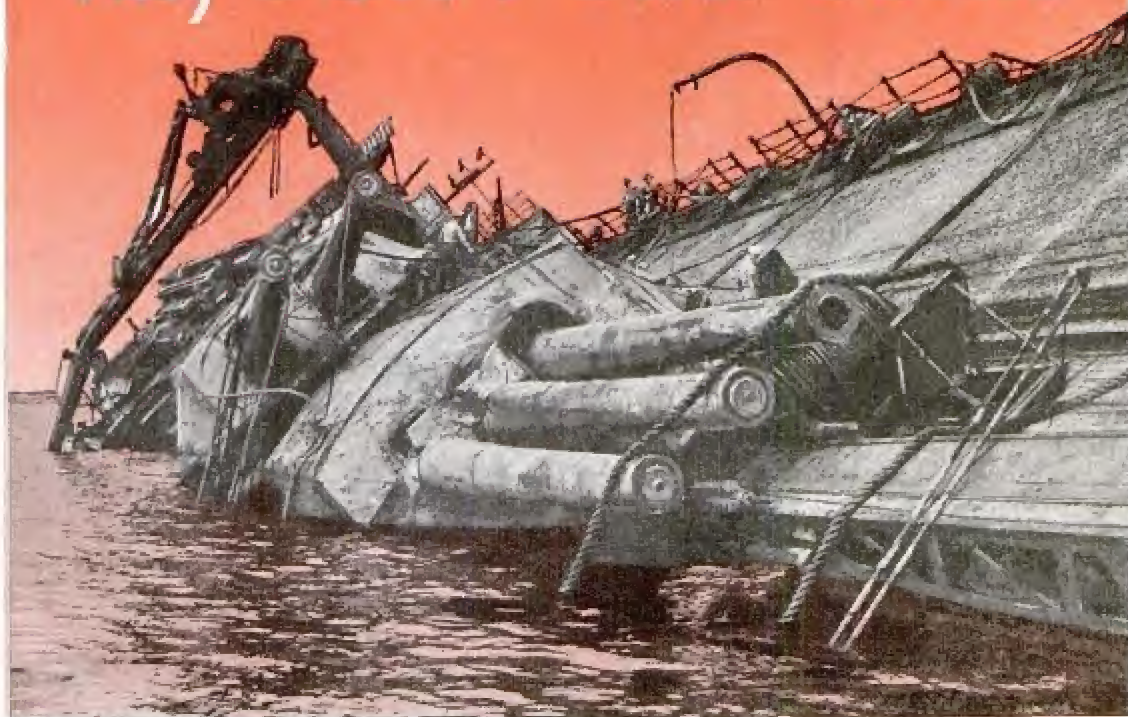
value of reducing "skin" friction for example, is shown by comparing the effects of airflow on a model with a rough surface and another with a smooth finish. The tunnel makes clear how the presence of a partial vacuum above the wing and high pressure underneath lifts a plane into the air. The classroom wind tunnel is 41 inches long, 27 inches wide and 26 inches high. It can be used with a 16-inch fan or small electric motor. The tunnel has a special propeller and the airflow is straightened out with a honeycomb at the entrance.

☞ Breakfast food, candy, and a sweet powder-mix for ice cream and pie are being made from the sweet potato.

Prof. L. M. Ware
Alabama Polytechnic Institute
Auburn, Ala.

Talado Scale Co., Toledo, Ohio

They DON'T STAY SUNK



Above, raising the barnacled battleship Oklahoma at Pearl Harbor. Below, repairing propeller of a merchant vessel at Todd Shipyards

By James Colvin

"THE cheapest and best way to build a ship is to repair one already built."

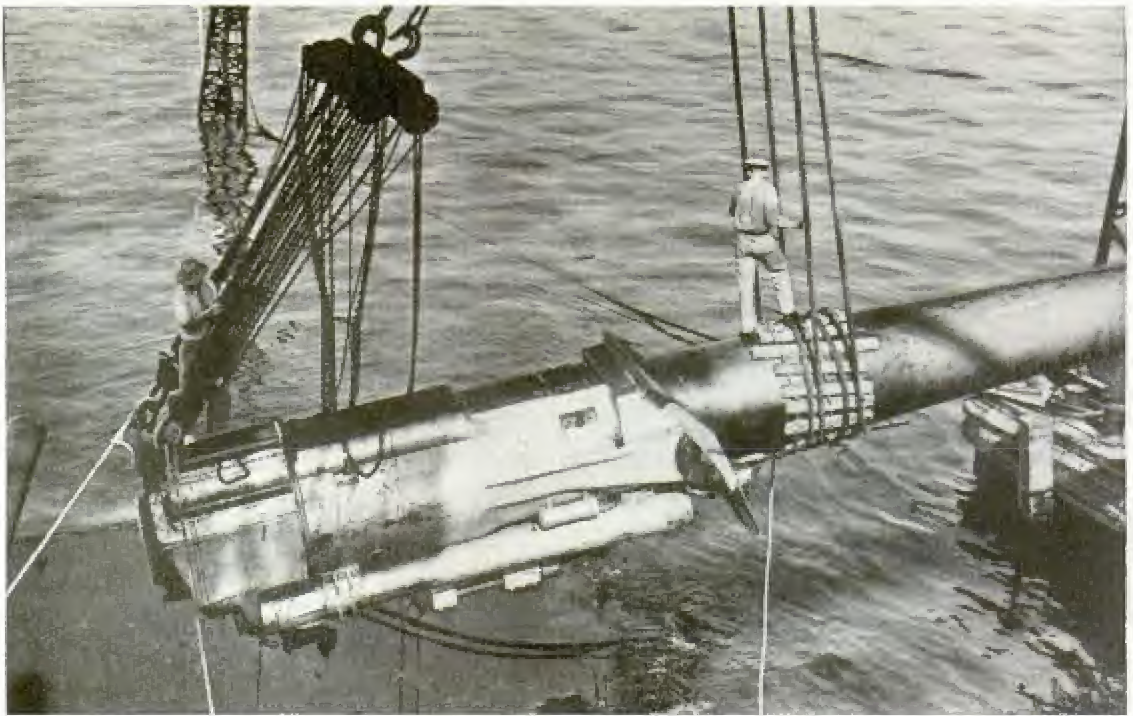
Thus Rear Admiral Ben Moreell, chief of the Navy's Bureau of Yards and Docks, tells why ship repairmen, though largely anonymous, have been among America's most important warriors of the production line.

During the worst of the submarine blitz, the Nazis claimed sinkings running as high as a million tons of ships a month. But during that same period one company alone, for instance, Todd Shipyards Corp., was turning out in new and repaired ships more ocean-going tonnage than even the Axis claimed. In a year's time, the Todd organization turned out 15,000,000 tons of new, converted, or repaired ships.

The Nazi submarine claims were probably part sheer lie and part misconception.



1. B. Moreell
77 71 77



One of the big guns is swung away from battleship California, hit at Pearl Harbor

They hit more ships than they sank, and even some they sent to the bottom have been raised, repaired, and sent back to sea.

Out of service a ship is merely a hulking, unwieldy mass of metal and machinery. But every repaired ship sent back to sea is the equivalent of a new vessel added to the ocean fleet. And, as often as not, a ship is better after it's repaired than it was before, for repair often includes modernization.

Most spectacular ship-repair achievement was the recovery of all but three of the 19 war vessels and auxiliaries blasted

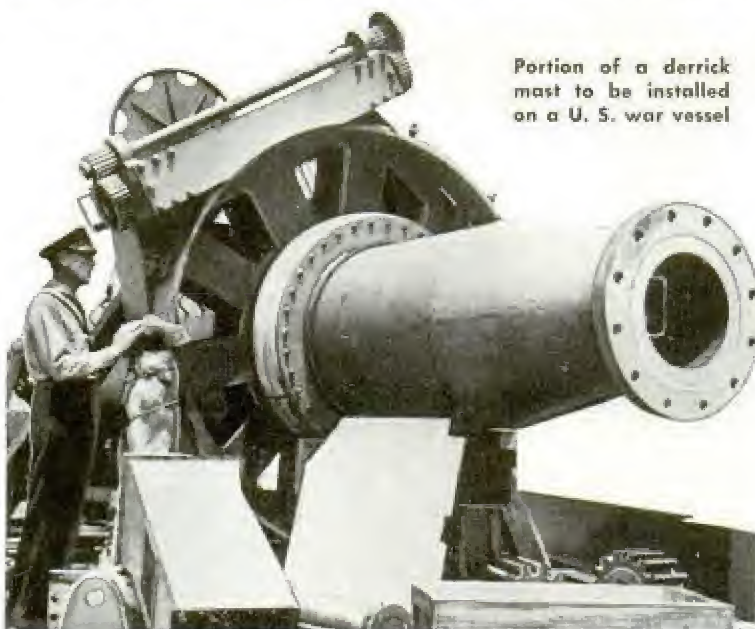
by the Japs at Pearl Harbor. Some of these battle casualties were back in service in days; others not for months.

Here is how Rear Admiral William R. Furlong, commandant of the Pearl Harbor Navy Yard, describes the task:

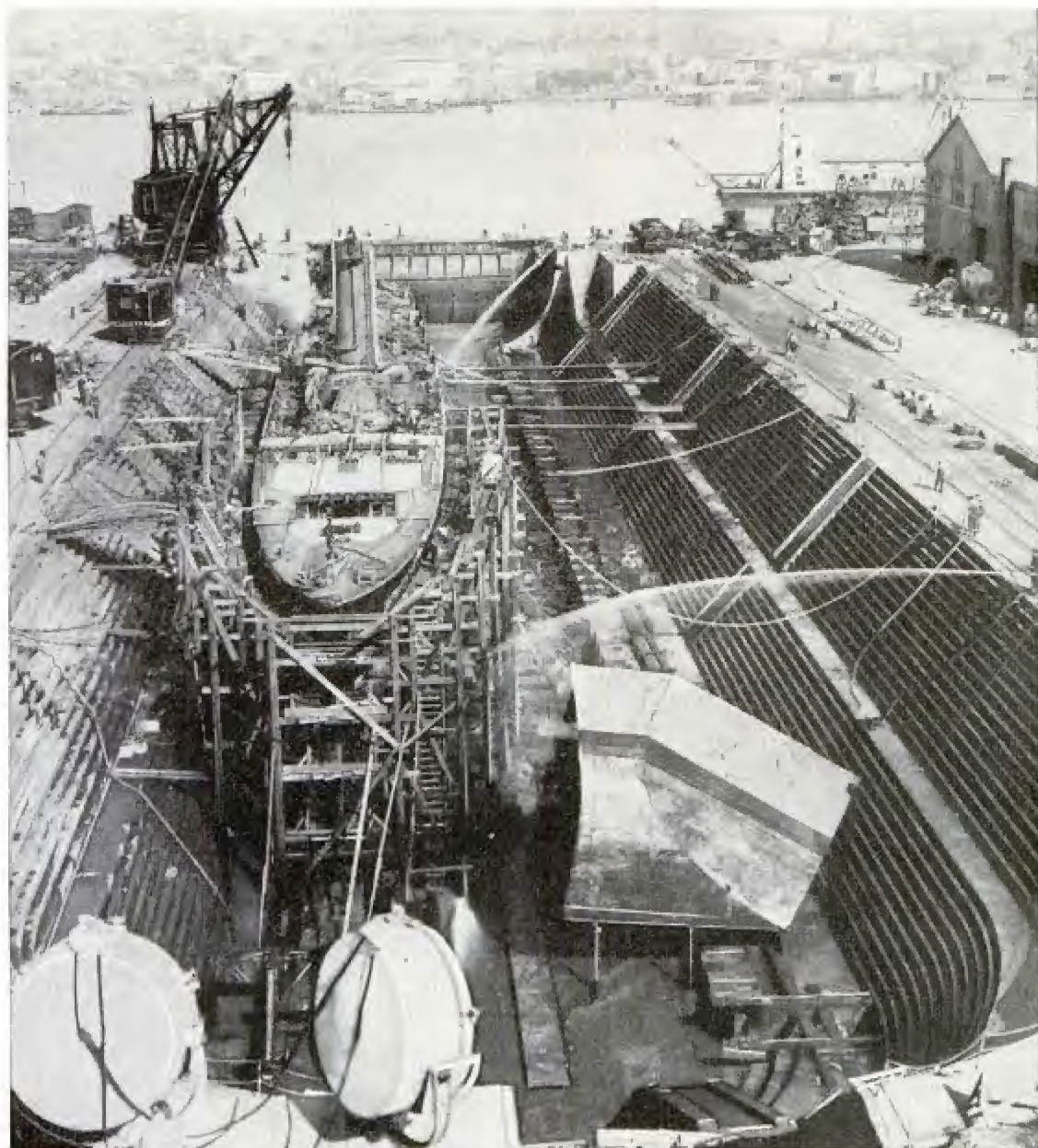
"You need all kinds of people for salvage. You must have divers, burners, mechanics who can work in diving suits under water, pumpers, electricians, and laborers. Once the ships are floated, all types of artisans more or less rebuild the ship."

"All types of artisans" is an understatement. Blacksmiths, ship fitters, dock masters, carpenters, machinists, welders, riggers, riveters, painters, engineers, pipe fitters, electricians, plumbers, steamfitters, turbine bladers — these are a few.

The comeback at Pearl Harbor is unsurpassed in history of maritime engineering. It was more difficult than the British task of salvaging the captive German ships scuttled at Scapa Flow after the first World War, because the German vessels had not suffered bomb or torpedo damage, while, inside and out, some of the ships pounded at Pearl Harbor



Portion of a derrick mast to be installed on a U. S. war vessel



In drydock, the U.S.S. Shaw is fitted with a new nose. At right, temporary bow used in trip from Hawaii

were a shambles. Wiring, machinery, furnishings were jumbled topsy-turvy inside them. They were silted up with mud, and everywhere coated so thick with gummy fuel oil that divers had to work largely by sense of touch. Oil fouled everything. But it also preserved metal under water, and made salvage of parts feasible.

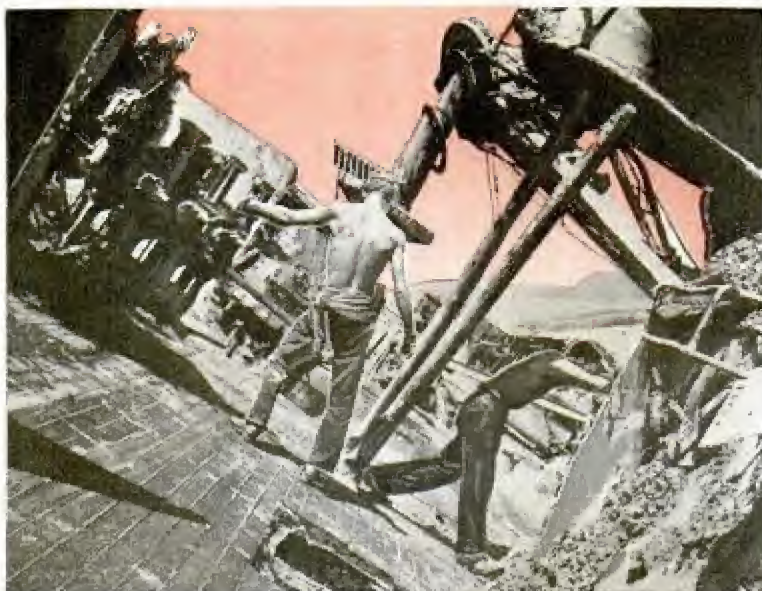
Sensational as was the Pearl Harbor achievement, it is being repeated in miniature day by day in shipyards that are the repair bases for merchantmen of the United Nations.

In some respects, these jobs are more difficult. For the Navy knew all about the ships sunk at Pearl Harbor. The Navy had supervised their building, had blueprints of

their construction. But consider the case of a torpedoed merchantman. Perhaps she is registered under the Norwegian flag, and is an old craft. The original plans of her construction are moldering somewhere in conquered Norway.

With no blueprints, repairmen must determine how she's built, and make their estimates of damage and plans for repair on the spot. They crawl over the wreck taking measurements, testing plates to see which must be replaced, and which may be faired by heating and pounding with heavy steel hammers.

Perhaps all that can be seen of damage from the outside is a few holes in the deck, or a few rivets shorn off and plates blown



Immersed 17 months, the Oklahoma was silted, its deck fouled with mud

away. But an exacting examination will disclose weakened and bent ribs, a strained keel, water-fouled engine and boiler rooms.

In one case at Todd Shipyards, 92,000 rivets had to be removed to get rid of bent frames and condemned plates. In that same repair job—a big one, but not untypical—the bilge keels had to be renewed, the whole stern overhauled, the top gudgeon for the pintle of the rudder removed and replaced, the lower portion of the bent frame heated and faired in place. A new rudder was built, and four new blades of the propeller installed.

All piping lines carried near the damaged portions of the hull had to be examined, and repaired or replaced as required. Main engines were removed and all cylinders, bearings and guides opened up for testing. All packing, metallic and soft, was renewed. All reversing and other gear was overhauled. The crank shaft was trued up, and the thrust shaft, boilers, and oil-burning equipment tested.

It sounds like a mammoth job, and it was. But it would have taken 100 times as long to build the same ship from scratch, and she left the yard a better vessel, with improvements to ventilating, electrical and wiring systems. These improvements were suggested by years of experience. Ship repair, in fact, has wisely been termed 99 percent experience and 1 percent theory.

Todd is proud of another job, a record-breaker. Sixty-four feet of

this vessel, the complete stern—including rudder, stern frame, propeller, tail shaft, two lengths of intermediate shaft and the section's machinery and fittings—were lost when she was rammed. As guides to reconstruction, the rebuilders had only a small-scale outline of the ship—telling little more than its shape—a deck plan and a photograph. Yet from these hints, the afterpart of the ship was completely rebuilt and she was ready for service in 18½ days!

Then there was the ship with the jackknifed keel.

When raised after an explosion, she was found to have a buckled keel, with the bow 9 feet 2 inches higher than the buckled spot, and the stern 6 feet 6 inches higher.

Delicate part of her repair job was settling the ship into drydock in such a way that she would not break apart. Yet so carefully was the water pumped out that, when the drydock was emptied, her entire keel fell neatly in place along the blocks.

The graving dock, essentially a short channel cut into the shore, is the heart of such repair work. First, the dock master must study the docking plan of the arriving ship. This plan shows her underwater contours, and allows him to arrange keel blocks and bilge blocks along the floor to cradle the ship. Then the dock is flooded to the level of the ocean, and the gate is moved out of the way.



Main pump control panel used for pumping a graving dock dry, also for flooding it



Result of the "deed that will live in infamy"—the U.S.S. Nevada burning and beached after Jap attack

The dock master directs the moving of the ship into the dock, and its positioning exactly over the blocks. The sea gate is hauled shut. Pumps begin the hours-long job of pumping it dry.

Drydocks themselves are only the operating tables of the marine hospitals. Adjacent are auxiliary piers, machine shops and fabricating shops, where anything from armor plate to tiny jewel bearings used in instruments can be serviced. Railroad cars, railway cranes and big gantry cranes run on tracks between the shops and the docks.

Concrete walls of the graving docks often contain galleries with connections for electric current, fresh water and sea water, compressed air, steam and gas.

The Navy disclosed months ago that it

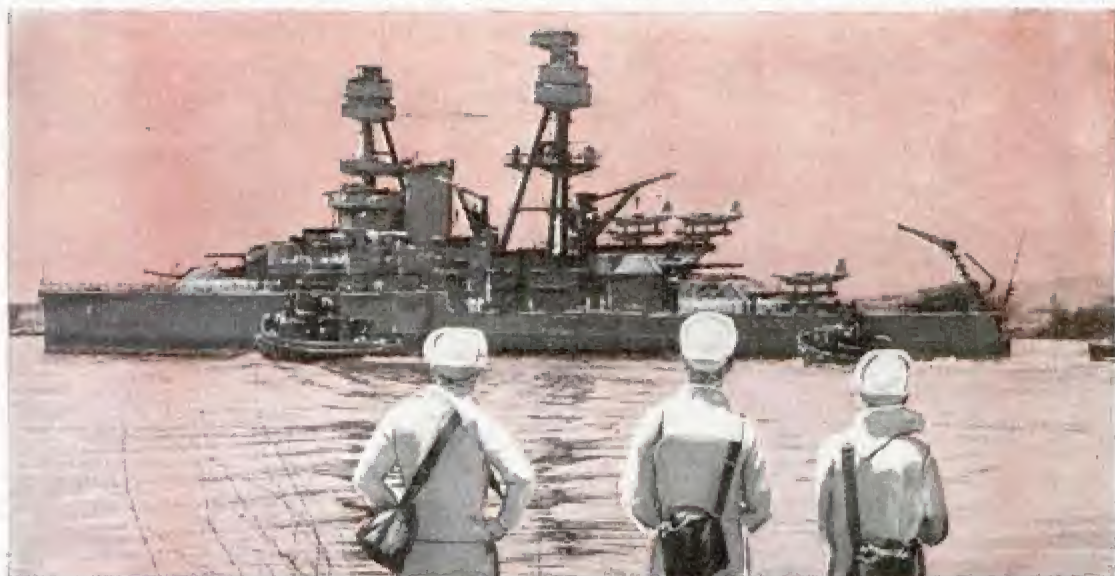
had under construction seagoing drydocks, big enough to accommodate battleships. Their construction was part of a program involving the building of 183 new docks, both floating or graving, or stationary.

Each section of these seagoing drydocks is a ship's hull in itself, with living space inside for the crews. Each section can be towed at 10 knots; it was even deemed feasible to make each section self-propelling. At their destination, submersion machinery "sinks" them beneath the surface.

Sections can be joined until the whole accommodates up to 100,000 tons. A battleship could be floated inside, and when the water was pumped out, repaired on the spot. They were made sectional for two

(Continued to page 154)

Comeback of the Nevada: With temporary repairs at Pearl Harbor, she steams for a drydock on mainland



Ocean-Hopping Glider Has Steel-Tube Frame



7/515
Dearborn, Mich.
Glider pilot's view of towing plane, taken over Ford airport, left. Lower left, "flying freight cars" peel off for a landing. Below, nose of glider opens to permit exit of jeep



Conservation of the scarce light metals was of primary importance in the design of the model CG4A glider, of the type that was recently towed across the Atlantic in history's first air-freight ocean crossing. Created by Waco, the craft has subsequently been mass-produced by firms that once made pianos, furniture, and automobiles, as well as aircraft. In the interests of conservation, its framework is made of tubular steel. Parts are of aircraft spruce and mahogany plywood; the skin is of long-fiber cotton fabric, and fixtures of plastic and wood. It is a big craft, with a fuselage 52 feet long, a wingspread of 84 feet, and a cargo-carrying capacity of one and one-half tons. As an alternative to that much freight, it can haul directly into battle 15 soldiers, and their combat equipment. Demand for this craft, and for a smaller one used in training, brought directly into the war program many workers with woodworking skills that had not previously been utilized in the battle of production. Airworthiness of the CG4A was conclusively proved in the ocean hop. But earlier, in rehearsal runs, it had shattered all records by a non-stop towed flight of 1,177 miles. Both the towing plane for the ocean hop,

a Douglas C-47 transport, and the glider were American made, but the crews of both were from the Royal Air Force Transport Command. The flight was of 3,500 miles, from Montreal to Britain, and consumed only 28 hours, with an unreported number of stops. The glider carried a pay load of vaccines, radio, aircraft and motor parts across the ocean. In the heavy clouds, pilot and co-pilot of the motorless craft frequently lost sight of the towing plane, and could judge their position in the air only by watching the towrope.

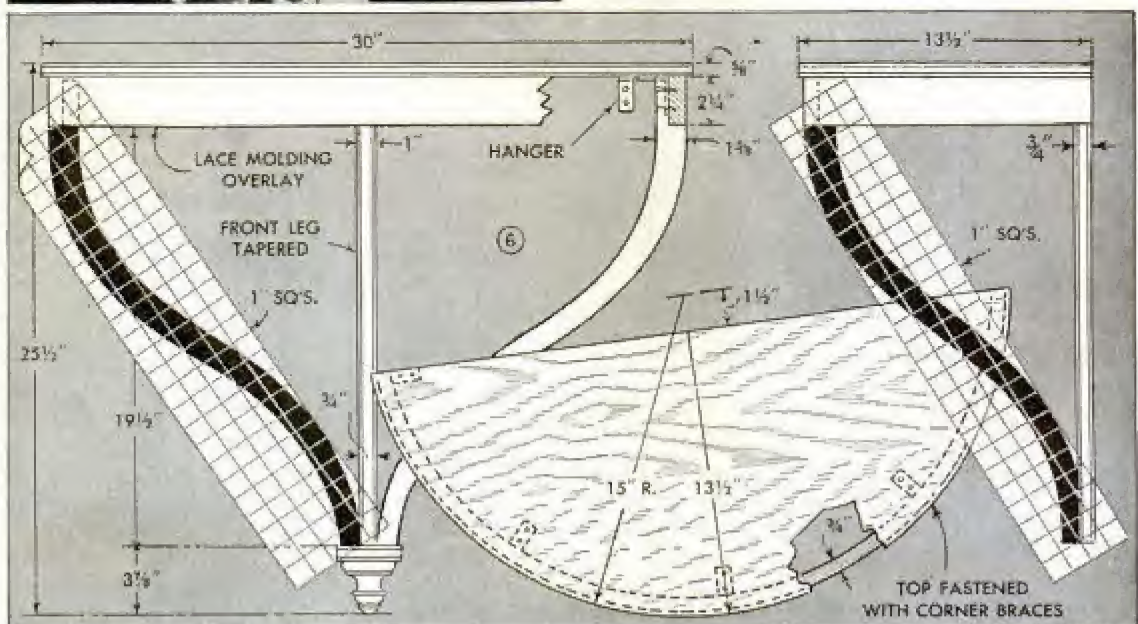
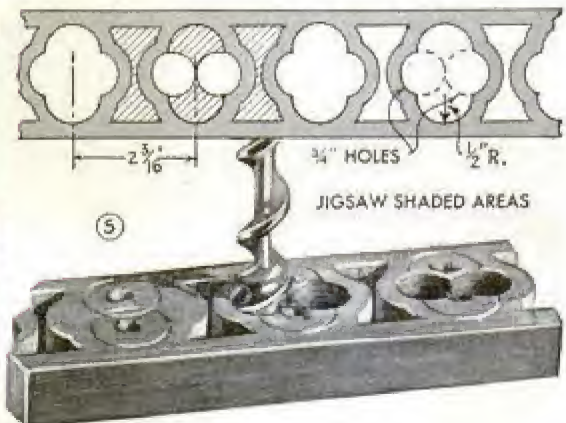
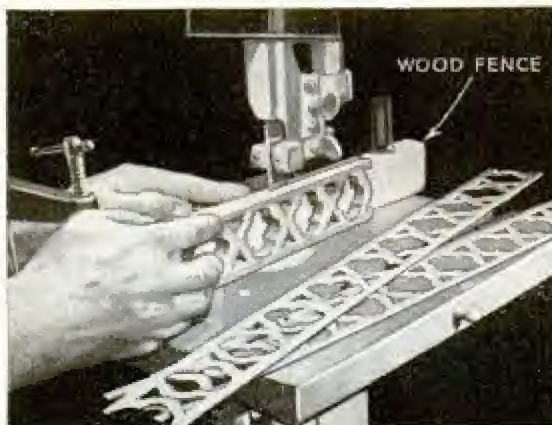
X-Ray Shows Effect of "Bends" Suffered at High Altitude

In decompression chambers which simulate flying at 38,000 feet, changes in the heart, lungs, joints and muscles are recorded on X-ray films. These changes, called "bends" by divers, are caused by the expansion of dissolved gases in the body. The X-ray transformer is located outside the test chamber with cables connecting it to the X-ray tube mounted on an adjustable stand inside. When the subject is ready to be X-rayed, he steps before the tube and places a plate holder containing a film 14 by 17 inches over wrist, knee, or stomach as directed. The operator outside turns a switch and the exposure is made. The films reveal surprisingly large gas bubbles, especially in the stomach where gas expands about six times at altitudes of seven or eight miles.



first, then add the others when the glue has dried. By steaming, or possibly just sponging, the apron can be built up of three strips ¼ in. thick. Next, you face both the inside and outside surfaces of the pine core with regular ¼-in. veneer, the outside being covered with finished stock to back the overlay which is added next. The overlay is made by cutting the design in a piece of ¾-in. walnut and slicing off ⅜-in. strips on a bandsaw as in Fig. 4. Uniformity of the circular openings in the overlay is had by using a wood bit as in Fig. 5 instead of sawing. As each strip is bandsawed, sand the face of the block smooth before making the next cut. Although the original overlay was cut from a short block and applied in several pieces, the strip can very well be made in one piece. Coat the strip sparingly with glue, so that when clamping it in place, excess glue will not ooze out into the openings.

The three "legs" can be cut from a board measuring 1 by 10 by 26 in. Note that the front leg has a different curve than the



others and that it tapers from 1 in. at the top to $\frac{3}{4}$ in. at the bottom. After the side legs are dressed down to $\frac{3}{4}$ in., run the beads in the edges to match those in the top. The legs terminate at the bottom in a two-part "split" turning, the upper part of which consists of a disk cut off at the back and fastened with a screw driven up into each leg. The lower part is likewise cut flush at the back after being turned and is glued in a blind hole in the bottom of the disk. Fig. 6 shows how the legs are notched and attached to the apron with screws from the inside and also how metal corner brackets are used to fasten the top. In mounting the table to a wall, locate the hanging brackets to permit the screws to be driven into studs.

A prepared varnish which resembles a hand-rubbed finish upon drying, is good to use in finishing the table, as it will save the work of rubbing down the overlay.

Rosin Flux Is Best To Solder Brass Or Copper

The problem of soldering many substances is not too little heat so much as using an iron far too hot. Rosin is used for a flux in soldering either copper or brass, not so much for its noncorrosive qualities, but because it allows the use of a much cooler iron. The next time you solder any of these materials use sal ammoniac and note how much hotter your iron must be to make a good job of the work. This increase in heat soon burns off the tip of the iron or pits it so badly that much of the copper is lost. —L. H. Georger, Buffalo, N. Y.

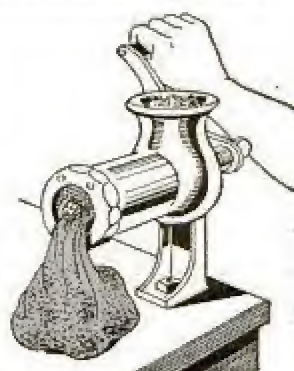
Combination Book and Carrying Case For Technical Men Who Travel



Officers and engineers in the armed forces, and others who move to different locations frequently, will find this portable case handy for their technical books. When closed, it provides a substantial carrying case that will stand shipping and when opened on a desk or table it serves as a bookcase. The case is made of $\frac{3}{4}$ -in. plywood of dimensions to suit the largest book to be accommodated. The ends are cut diagonally as pictured, and long, heavy screws are used for the assembly. Trunk fittings are put on both ends. The handle is bolted on the part that becomes the back when the case is used as a bookcase. Shellac and varnish provide a good finish.—Carroll E. Bradberry, Berkeley, Calif.

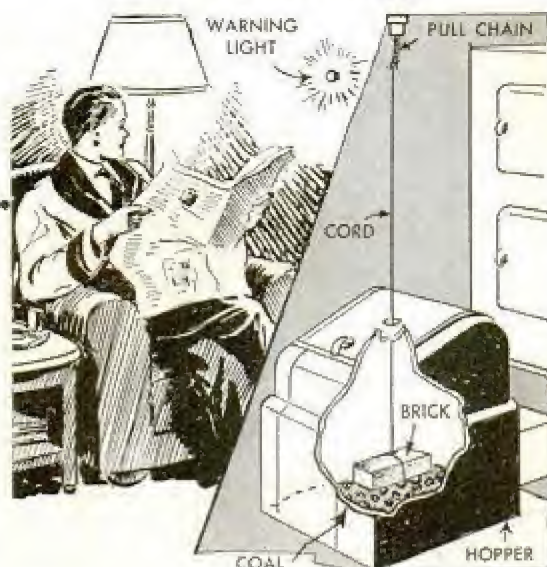
Meat Grinder Reconditions Modeling Clay

A teacher of an art class found that modeling clay could be mixed or reconditioned much easier by running it through a meat grinder or a food chopper than could be done by hand. Usually, it was necessary to run the clay through the chopper two or three times. Any binder that was required to bring the clay to the desired consistency was added as the clay passed through the chopper, which mixed it in thoroughly.



¶To see inside a chimney, hold a mirror at an angle inside the smokepipe hole and you can see to the chimney top.

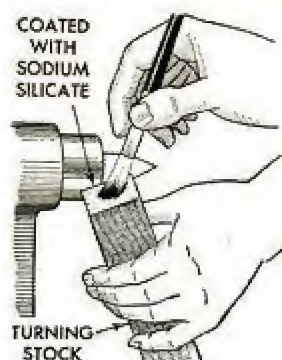
Light Warns When Coal Gets Low In the Stoker Hopper



If you sometimes forget to fill the hopper of your automatic stoker, a light located in a conspicuous place in the house and controlled as shown will serve as a warning to fill the hopper. A pull-chain switch is located on the basement ceiling directly above the center of the stoker hopper and is wired in the lamp circuit. Then, a brick or other suitable weight is attached to the pull chain of the switch by means of a length of strong cord, which passes through a tiny hole in the cover of the stoker. The cord should be just long enough so that the weight will operate the switch when the fuel level in the hopper reaches a predetermined height. Of course, the brick must be removed and placed on top of the fuel each time the hopper is filled.

—John W. Gunn, Winnipeg, Can.

Lathe Center Holes in Soft Wood Hardened for Easy Turning

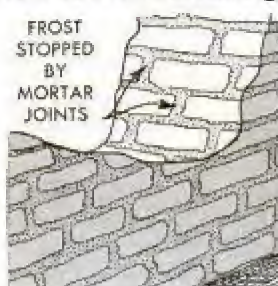


Any tendency of the lathe tail-stock center to enlarge the hole in soft wood when turning it so that the work cannot be trued accurately, can be avoided by hardening the wood surface at this point with silicate of soda. After locating the center of the work and before putting it in the lathe for turning, apply the silicate of soda liberally where the lathe center will

contact the work. This treatment permits thorough lubrication at the point of contact between the lathe center and the work and allows the latter to be supported snugly between the lathe centers.

W. T. M. Concrete Mortar Insulates Stone Building

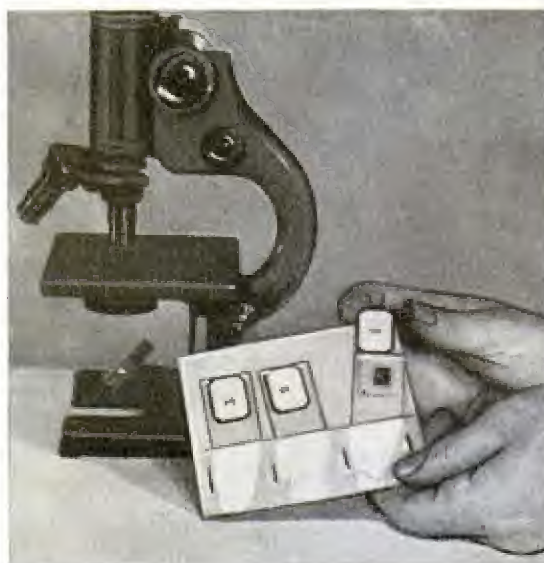
When building a cabin or cottage of field stone, it is best to avoid the use of any stones that are wide enough to reach across the entire thickness of the wall. Cold penetrates such stones rapidly, depending on their porosity, and makes the building hard to heat. Furthermore, moisture may condense on the inner surface of the wall, and in extreme cold weather may even form ice on the walls. However, if smaller stones are used, making one or more mortar joints necessary across the thickness of the wall for each layer of stone, the mortar, being highly porous, will act as insulation.



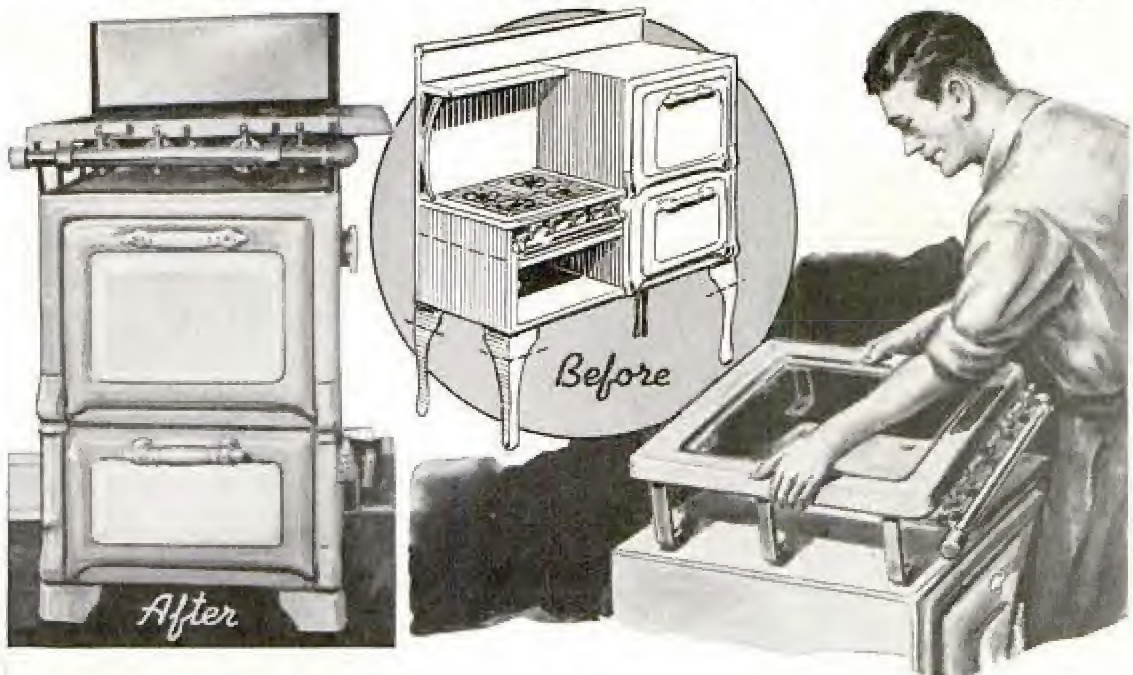
Storing Microscope Slides

Made easily from thin cardboard, the holder shown will help to keep your microscope slides in order and protect them from breakage. To make a holder, use a piece of cardboard 5 in. square. Draw a line across it 1½ in. from one end and fold it along this line. At 1½-in. intervals, staple the folded cardboard, beginning ¼ in. from one edge. Holders for more slides can be made by adding 1½ in. to the width of the cardboard for each extra pocket.

—H. F. Whittaker, Toronto, Ont., Can.



Gas Range Converted to Modern Vertical Type



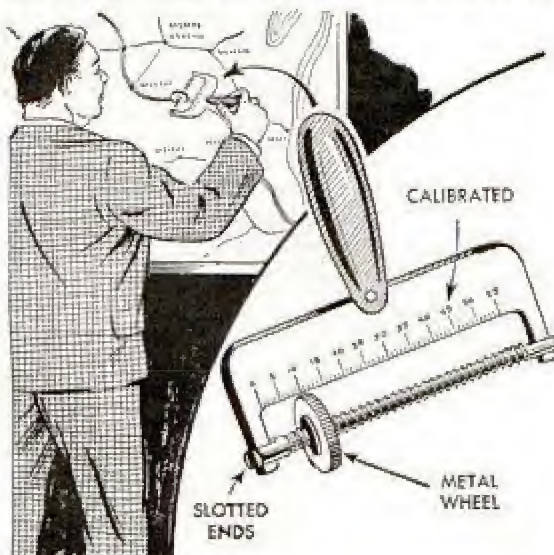
Needing a small gas stove of the vertical type for use in a basement apartment, I converted an old-style gas range for the purpose, and produced a neat modern stove complete with oven and broiler. To do this, I first removed the burners and their supports as well as all back and side parts. Then I sawed through the stove frame next to the oven and broiler, leaving them intact in one unit, which was used for the

new stove. After mounting the burners on top of the oven by means of suitable supports bent from flat iron, the frame was cut down to the desired size and riveted together to support the stove thus formed. The legs, of course, were cut off to give the stove the desired height, after which the gas line was connected to both the cooking burners and the oven.

—Lawrence Oncley, Winfield, Kan.

Rolling "Ruler" to Measure Irregular Distances on a Map

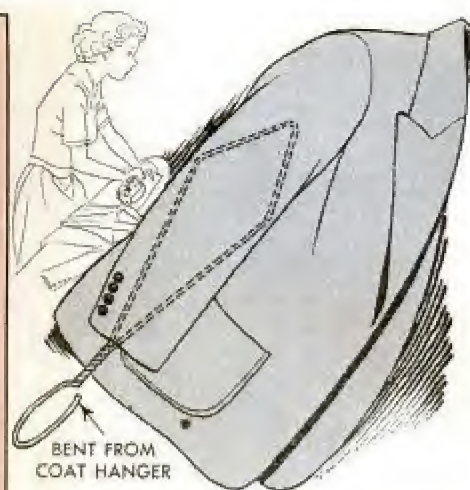
Measuring distances on maps is simplified with this unusual ruler, on which the rotations of a small knurled wheel of known circumference are shown on a scale.



To make a measurement, run the ruler over the line to be measured, note the number of wheel revolutions, and then multiply this number by the circumference of the wheel in inches to get the length of the line. Now, by multiplying the length of the line in inches by the number of miles per inch, as indicated on the map scale, you get the length of the line in miles. It will simplify your problem if the wheel used has a circumference of exactly 1, 2 or 3 in. Also, it will be necessary to divide the circumference in an equal number of divisions so that fractions of wheel revolutions will be indicated. The divisions are best indicated by scores on one side of the wheel. In calibrating the ruler, start with the wheel at the limit of the threads on the shaft, and make a line on the scale parallel with one edge of the wheel, repeating this operation for each wheel revolution across the scale. Marking the first line with zero, and numbering every fifth line thereafter will simplify reading the scale.



With a wooden "tong" like this one, which is cut to grip the neck of a hot-water bottle, you'll not be taking a chance of accidentally scalding your fingers when filling it



Sleeve linings are smoothed with less difficulty while pressing if a wire coat hanger, bent as shown, is inserted into the sleeve. The hook makes a convenient handle

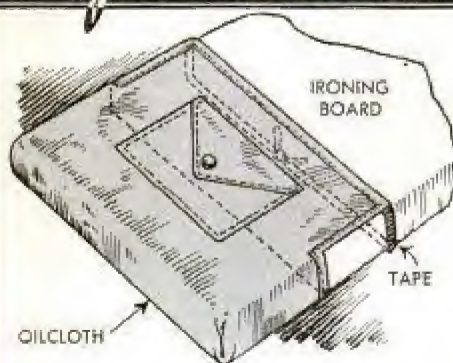


When sprinkling laundry for ironing it damp, the pieces that are not color-fast can be kept from staining the others, and from drying out, by wrapping in waxed paper



An eggbeater can be operated much faster without splat-tering, if the whipping is done in a fish bowl, as the crowning top of the bowl serves to catch the flying drops

Solving HOME



Above: To keep an ironing board from becoming soiled if it rests on the floor in storage, pull an oilcloth slip cover over the end. An attached pocket keeps a pressing cloth handy. Below: It's easy to find a key in your purse if you tie it to a bead or button, which is left hanging outside when the purse is closed



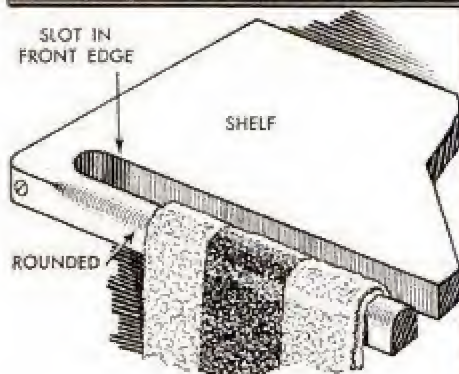


Paintbrush cleaning is simplified by working the brush over a piece of discarded screen wire cut and bent as shown to fit into the can containing the paint solvent

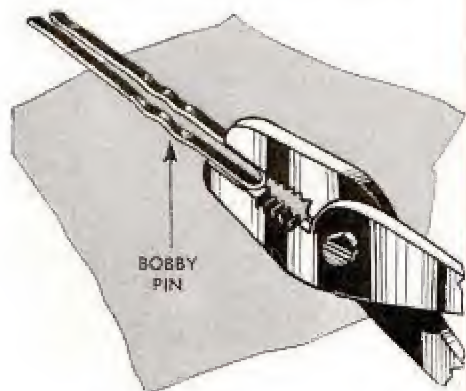


A neat and convenient way to hang a small stepladder on the back of a closet door, is to fasten spools to the ladder to hook over wire coat hooks screwed in the door

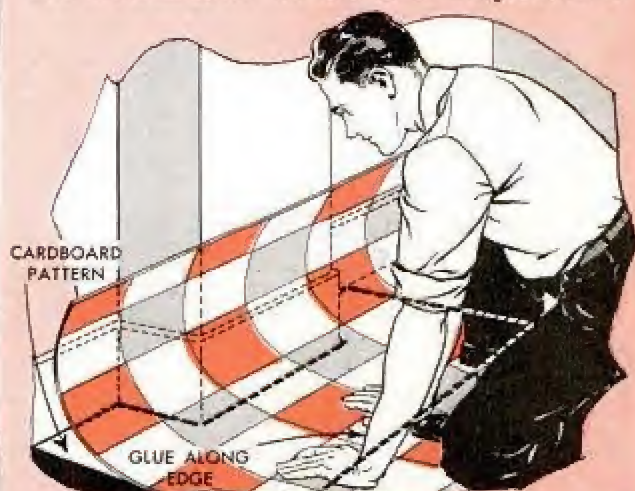
PROBLEMS



Above: You can incorporate a towel rack into any shelf simply by cutting a slot the full length of the shelf, part of which is illustrated. A long screw in each end reinforces it. Below: Most sprung bobby pins can be renewed as often as necessary if grasped with pliers at the end as shown and the sprung tips pressed together

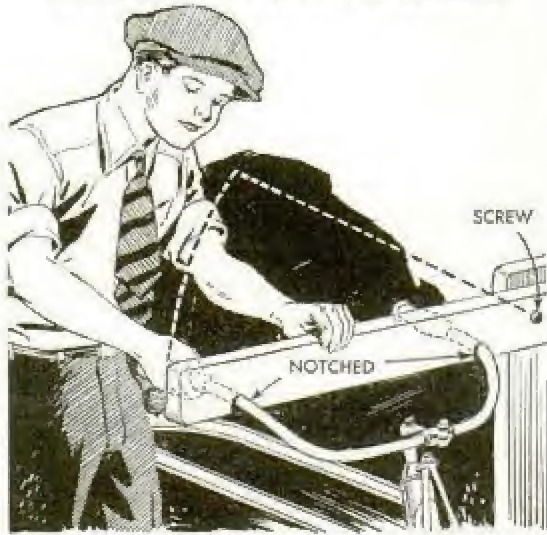


To prevent a window shade from flapping when the top sash is lowered, fasten a metal turnbutton to the underside of the sill so that the cord can be wedged under it



It's easy to fit linoleum around a chimney or pipes if a pattern, coated with glue, is placed on the floor so that it will stick to the back of the linoleum for marking

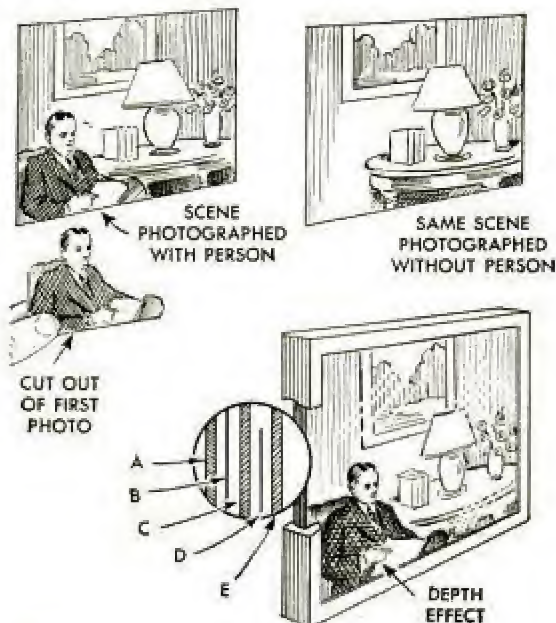
Simple Stock Holds Your Bicycle Securely in Vertical Position



Instead of leaning a bicycle against a post, building or similar support where it may fall, provide this simple stock, which will hold it securely. The stock consists of a length of 2 by 4-in. wood, which is notched to fit over the handlebars and is pivoted by means of a screw or bolt to a post, or even the side of a building.

Built-Up Picture Has Depth Effect When Displayed on a Wall

You will be surprised at the third dimensional effect produced in this picture, which is easy to make and requires little material. First, photograph a person well in the foreground, with regular room appointments in the background. Then, have the person step out of the scene and, with-

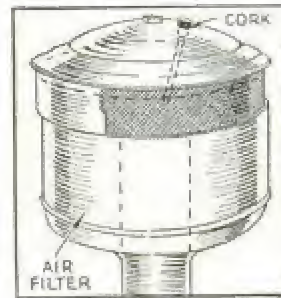


out disturbing any of the properties, photograph the background. When the prints are made, cut the picture of the person from the first photo and mount it on the front of a piece of glass. Mount the photo of the background on the back of the same piece of glass. Next, make a frame, using stock that can be rabbeted deep enough to accommodate a piece of cardboard and two pieces of glass. Now, assemble the parts in the frame as indicated in the circular detail, first the glass front E, then glass C with photos B and D mounted on it, and lastly cardboard A, which serves as a backing to hold the assembly in the frame.

—Opie Read, Jr., Chicago.

Priming Cup in Top of Air Filter Aids in Starting Cold Car

To facilitate starting my car motor on extremely cold mornings, I installed a priming cup in the top of the air filter so that a small amount of gasoline could be



injected into the carburetor easily. The cup consists of a length of tubing fastened in a hole drilled through the top of the filter and the felt pad underneath the top. A spring-cover oil cup of the type used on starters

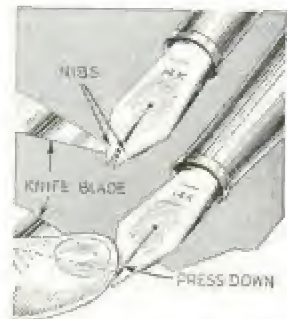
and generators was soldered to the upper end of the tube to prevent dust from entering. Another method of doing this is to drill a hole through the top of the filter and felt pad and keep the hole closed with a small cork.

—Albert G. Clarke, San Jose, Calif.

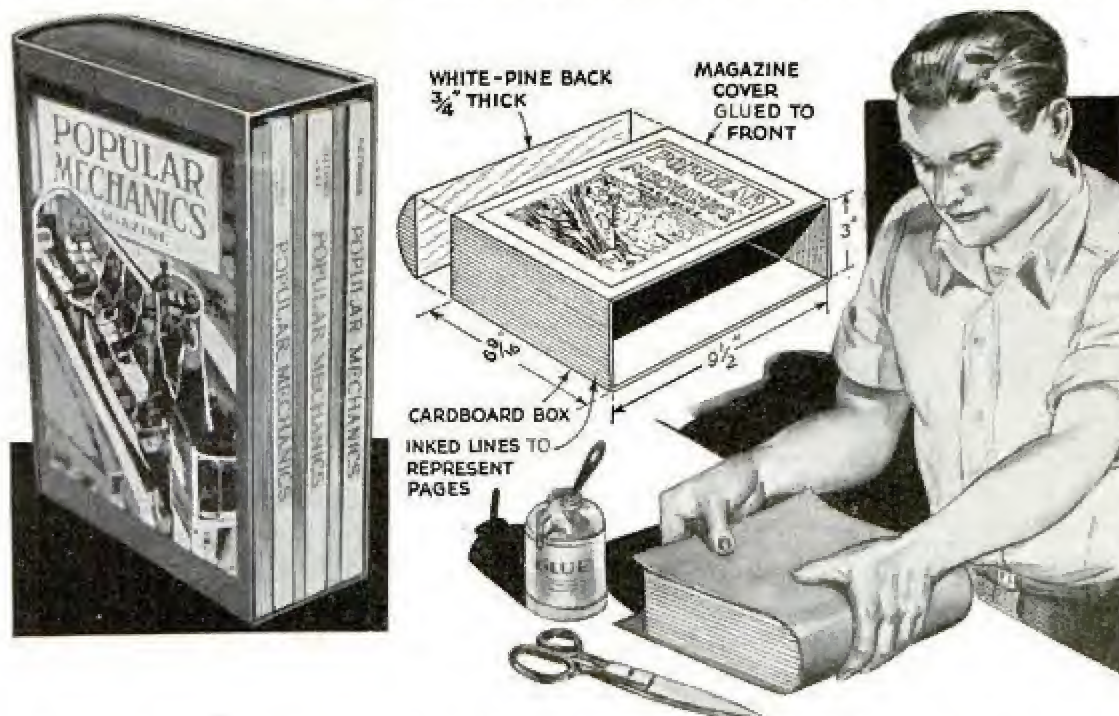
Repairing Point on Fountain Pen

If you accidentally drop your fountain pen and bend its point, it often can be repaired with a pocket knife. If the nibs of the pen are bent but not broken, insert the end of the knife blade about $\frac{1}{8}$ in. under one nib and apply pressure with the thumb as indicated. Repeat the operation on the other nib. With care the point can be restored to perfect alignment by this method.

—Thos. K. MacDonell, Coconut Grove, Fla.



"Book Binder" Holds Your Favorite Magazines



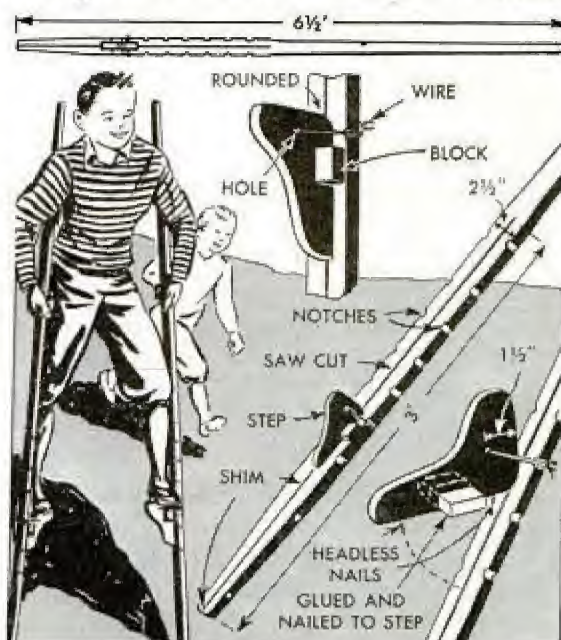
Copies of your favorite magazine will always be in neat order and conveniently at hand if you file them in a number of holders or binders like this one, which can be kept right in your bookcase, or between book ends. Being nothing more than a cardboard box with the rear side open, the binder is provided with a rounded wooden block at the front side to simulate the ap-

pearance of a book. Inking closely spaced lines at the ends to imitate pages, and providing a cloth cover further the deceptive appearance. While the binder can be made to take a magazine of any size, it is best suited to one of a size comparable to most books. Usually, a binder wide enough to accommodate six issues is the most convenient.—Walter E. Burton, Akron, Ohio.

Stilts Instantly Adjusted in Height to Suit Skill of Users

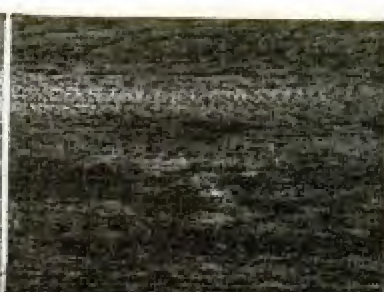
Fitted with steps that can be adjusted from 1 to 3 ft. above the ground, these stilts are of great help to a beginner as the steps are set low while he is learning and are raised when he becomes more skillful. Also, the stilts are ideal where they are used by several boys of different ages, as the steps can be adjusted instantly to suit the various users. Each step is held in position by a wire loop that fits notches cut in opposite sides of the stilt. Two headless nails, projecting from the inside edge of the step, slide in a slot to keep the step from moving sideways, the slot being made by sawing from the lower end of the stilt up through the center for a distance of 3 ft. A short, horizontal block set into the inside edge of the step flush with the surface prevents it from tilting. To adjust a step, raise the lower end so that the wire loop loosens and can be moved up or down to a different notch.

—Frank S. Leitch, Stamford, Conn.

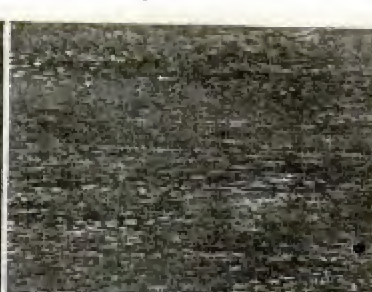




A SAME-COLOR FILLER



B DARK-COLOR FILLER



C LIGHT-COLOR FILLER

Application of

By Sam Brown



Mixing the filler-

1

Paste wood filler is thinned with naphtha or gum turpentine to resemble thick paint



Brushing the filler-

2

Apply a liberal quantity of filler; brush thoroughly in the direction of wood grain

WOOD having open pores, such as oak, walnut and mahogany, requires a coat of paste wood filler to build a level surface for the application of top finish coats. Besides this prime purpose, the filler plays an important role in coloration and in emphasizing the grain. The color of the filler usually is a shade darker than the stained color of the wood, producing the effect

shown in photo A above. A very dark, nearly black filler often is used to bring out the grain, photo B, while white and brightly colored fillers are used for novelty effects as in photo C.

Mixing the filler: Filler is purchased in 1, 5 and 25-lb. cans, and also in pint and quart containers. The material is in heavy paste form, the mix consisting mainly of silex (powdered rock quartz), together with a small amount of linseed oil and japan drier. Before use, the paste is thinned to the desired consistency as needed with naphtha or gum turpentine, Fig. 1, the amount of dilution depending on the size of the pores to be filled. Obviously, large pores require a thicker mix than small ones. Table No. 2 is a partial guide to the mix required for various domestic and im-

PROPORTIONS FOR MIXING VARIOUS QUANTITIES OF FILLER						TABLE NO. 1		
HEAVY MIX (16-LB. BASE)			MEDIUM MIX (12-LB. BASE)			THIN MIX (8-LB. BASE)		
APPROX. AMT. NEEDED *	PASTE	THINNER	APPROX. AMT. NEEDED *	PASTE	THINNER	APPROX. AMT. NEEDED *	PASTE	THINNER
2 GALS.	16 LBS.	1 GAL.	1 GAL., 3 QTS.	12 LBS.	1 GAL.	1½ GALS.	8 LBS.	1 GAL.
5 PTS.	5 LBS.	2½ PTS.	3 QTS.	5 LBS.	3 PTS., 5 OZ.	1 GAL.	5 LBS.	5 PTS.
2 QTS.	1 QT.	1 QT.	2 QTS., 10 OZ.	1 QT.	2 PTS., 10 OZ.	3 QTS.	1 QT.	2 QTS.
2 PTS.	1 PT.	1 PT.	1 QT., 5 OZ.	1 PT.	1 PT., 5 OZ.	3 PTS.	1 PT.	2 PTS.
1 PT.	1 LB.	½ PT.	1 PT., 2 OZ.	1 LB.	10½ OZ.	1½ PTS.	1 LB.	1 PT.
½ PT.	½ LB.	4 OZ.	9 OZ.	½ LB.	5½ OZ.	12 OZ.	½ LB.	½ PT.

* 1 PINT THINNED FILLER COVERS APPROX. 35 SQ. FT.

FILLER MIX REQUIRED FOR VARIOUS WOODS			TABLE NO. 2
NO FILLER NEEDED	THIN FILLER	MEDIUM FILLER	HEAVY FILLER
BASSWOOD CEDAR CYPRESS FIR HEMLOCK MAGNOLIA PINE POPLAR SPRUCE WILLOW	ALDER BEECH BIRCH BOXWOOD CHERRY GUM IRONWOOD MAPLE SYCAMORE TUPELO	AMARANTH AYODIRE BENIN BUTTERNUT MAHOGANY ORIENTALWOOD PRIMA VERA PURPLEHEART ROSEWOOD WALNUT ZEBRAWOOD	ASH BUBINGA CHESTNUT KELOBRA LOCUST MAHOGANY (Phil.) OAK PADAUK TEAK TAMO

FILLER *in Finishing*

ported woods. Table No. 1 gives proportions for heavy, medium and thin mixtures in various quantities. Only enough filler needed for the job at hand should be mixed, as the thinned filler thickens after a few hours and becomes useless. Mixing by exact weights (Table No. 1) is always good practice. The heavy mix (16 lbs. of paste per gallon of thinner) can be approximated in any quantity by adding thinner in the same volume as the paste. The heavy mix should not be confused as meaning a heavy-bodied material. Actually, the consistency is no heavier than varnish. The first step in mixing is to spade thoroughly the original paste in the container with a putty knife, then add a very small amount of thinner and stir again until thoroughly mixed. After the initial mixing, increasingly larger amounts of thinner can be added and stirred in until the mix is the proper consistency. Do not make the mistake of adding a lot of thinner at the start, as this makes mixing doubly difficult. Use naphtha for thinning if you want the filler to set up quickly for wiping, and use turpentine to hold the coat open longer. Or, you can mix the two liquids together if desired, making the proportions suitable to obtain the desired results. A small amount of boiled linseed oil can be added to hold the coat open for 30 or 40 minutes. The reverse of this—a very quick-setting filler—can be obtained by adding a small amount of japan drier.

Brushing the filler: Use a short-bristle brush of convenient size. Apply filler liberally, brushing thoroughly with the grain of the wood as shown in Fig. 2. Do not cover more than 8 to 10 sq. ft. of surface at one time, otherwise you will get ahead of the wiping and cleaning-up operations that follow.

Padding-in: As soon as spots on the



3 *Padding-in-*

This is done easily with a felt pad, which is used with a circular motion to pack the filler tightly into the pores of the wood



4 *Towing-off-*

Cuts surplus filler from wood surface and is done as soon as the filler starts to dry



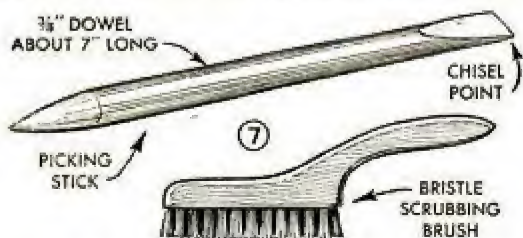
5 *Wiping-*

This is done with the grain to remove all remaining traces of filler on the surface



Wipers-

These are for removing surplus filler from the work and can be any cheap, coarse material. Open-weave cloth wipers are cleanest to use but most expensive



filled surface being worked become dull, the filler coat is ready for wiping. Do not wait until the whole surface becomes dull as this will make the job more difficult. The first stage in cleaning off the surplus filler is padding-in. This is done with a felt block or a smooth pad of cloth, the motion of the pad being circular but mostly across the grain, Fig. 3. This operation does not

CHEESE CLOTH is an excellent wiper but is a little too expensive for regular work. Open-mesh grade is best TOBACCO CLOTH is unbleached cheesecloth. This provides an excellent wiper and is clean to use. Cheapest grade gives best results because of its open mesh BURLAP is an old favorite for wiping. It is clean to use and cuts the filler level with wood surface. The cheaper grades are best because of more open mesh WOOD WOOL or excelsior in the finer grades is very inexpensive and makes an excellent wiping material. The coarse grades will scratch fine cabinet woods TOW from jute fibers is good, inexpensive wiper. Breaking up of material can be avoided by dampening MOSS costs more than tow but it hangs together much better; is a cleaner as well as a faster wiper FELT BLOCK is for padding-in before towing-off filler. It should be 1/2 in. thick, or thinner piece wood-backed

STANDARD FILLER COLORS TABLE NO. 3

BLACK: Add drop black to natural filler. Suitable for blackwood or dark mahogany.

WHITE: Color natural base with zinc oxide. Used for limed oak and similar effects on chestnut and ash.

LIGHT BROWN: Tint with Van Dyke brown to required shade. Can be used on any light brown-color wood.

DARK BROWN: Van Dyke brown with a touch of drop black. For walnut, mahogany, etc. Suitable for any medium to dark-color wood.

WALNUT: Half and half Van Dyke brown and burnt umber.

LIGHT RED: Use any red color (Indian red) in oil or japan, toning darker or lighter with drop black or zinc white.

DARK RED: Equal parts of burnt umber and rose pink. Add drop black for darker shade. Used for Sheraton mahogany or any other red finish where dark pores are desirable.

AMBER: Tint natural base with yellow or orange oil colors. Suitable for ambered walnut, harvest wheat mahogany and other bleached finishes.



Coloring the filler-

Pigment colors ground in oil of japan are used for this purpose, usually only a very small quantity of color being required to produce the desired shade

clean off the filler. Instead, it is intended only to force or pack the filler into the wood pores. You can do a very good job of padding-in with the heel of your hand. Many finishers omit padding-in altogether, proceeding directly after application to towing-off, Fig. 4, in which the surplus filler is packed into the wood and cut off level with the surface in one operation.

Towing-off: The work is towed-off with tow, moss, burlap or any other coarse, cheap material (see Fig. 6). Wiping is done across the grain, as shown in Fig. 4. The pad of wiping material should be turned around or refolded frequently to bring a clean surface in contact with the filler. The work should be cleaned thoroughly and progressively from one end to the other, not just half-wiped all over and then gone over again. If the filler has set up too hard for easy wiping, the surface of the work or wiping pad can be moistened with naphtha or the whole surface can be recoated with filler, which will tend to soften the filler coat underneath.

Wiping: Final wiping is done with the grain of the wood, using any soft lintless cloth, Fig. 5. This serves to remove any slight traces of filler missed in towing-off. The cloth can be moistened with benzine for a final wipe. Inside corners and other hard-to-reach places can be wiped clean with a picking stick as shown in Figs. 7 and 8. The stick consists of a short dowel having a round point at the end and a chisel edge at the other. A bristle scrubbing brush is useful for cleaning filler from intricate carvings, but in no case should it be used when the work can be wiped. If one coat of filler fails to fill the pores flush with the surface, apply another, tow-off as before and wipe lightly to avoid pulling out the filler.

The finishing schedule: The place of filler in the finishing schedule is best told by following a typical complete schedule. Staining usually is the first operation. The stain coat should be sealed with a wash coat of shellac or lacquer (1 part shellac or lacquer to 6 parts thinner). The work is sanded lightly with 5/0 paper when dry and, after a thorough cleaning with a duster or compressed air, it is ready for the filler coat. The filler coat should dry 6 hours if the filler is the quick-drying type. If a slow-drying type is used, 24 to 36 hours drying time should be allowed. The dry filler coat then is sealed with a light coat of shellac or lacquer sealer. When dry, this is sanded lightly, after which the work is given a full-bodied coat of varnish (varnish finish) or lacquer sealer (lacquer finish). This coat fills any tiny open pores, and should be sanded thoroughly to a flat, smooth surface. Top coats of varnish or lacquer complete the finish.

Filler colors: Paste filler can be obtained in all standard wood colors, also white and natural (the color of pale linseed oil). Common colors such as walnut, oak and



Turned work-

Turnings can be towed-off while the work is rotating at slow speed in the lathe. The work should be sanded very smooth as any sandpaper rings will pick up and hold filler. Turnings on furniture are towed-off by hand



mahogany are best purchased ready-mixed. These can be shaded lighter or darker to suit by adding a small amount of pigment color ground in oil or japan, and the natural filler can be shaded any color desired by adding oil or japan colors. The color should be mixed separately, using a very small amount of turpentine, Fig. 9, after which it can be added to the filler, preferably through a strainer. Table No. 3 gives formulas to mix colored fillers for various finishes.

Staining filler: Filler that stains and fills in one operation can be made by adding a small amount of oil stain to the paste filler. This is sometimes useful when exact monotone effects are desired, but generally is considered a short-cut practice suitable only for cheap work.

Turnings: Any turning that is a complete project in itself, such as a candlestick, can be filled and then towed-off with the work rotating at slow speed in a lathe as shown in Fig. 10.

Two-toning: One of the many methods of producing two-tone work can be done with filler. Areas to remain light are masked with tape after the whole panel has been stained, Fig. 11. The filler then is applied, Fig. 12, and when the tape is removed it produces the effect shown in Fig. 13, the



Two-toning-

This is done by masking areas to remain light and then applying filler in the usual manner

FILLER DEFECTS		TABLE NO. 4
Defect	Cause	Remedy
PIN-HOLES	Usually too thick filler which bridges pores. Trapped gas in pores then explodes forming miniature volcano.	Use a thinner filler. Avoid use of japan in mixing. Dust work thoroughly before filling.
RAISED GRAIN	Filler not given enough drying time. Also, in lacquer finish, the use of a filler not suitable under lacquer.	Allow plenty of drying time. Use 5/0 paper to sand off surface fuzz before and after staining.
GRAY PORES	Moisture in wood. Not enough drying time. Filler too light in color.	Check moisture content of wood. Always use filler as dark or darker than stain.
STREAKED CLOUDY FINISH	Filler not cleaned off completely. Use of wood turpentine instead of gum turpentine in mixing filler.	Moisten wiping rag with naphtha for final wipe of filler coat. Use gum turps or naphtha for mixing filler.

protected areas standing out both because they are lighter and also because they were not filled. For sharper contrast, a small amount of oil stain can be added to the filler.

Filler defects: The four most common finishing defects traceable to improper application of filler are described in Table No. 4. Augmenting this table and summarizing good filler practice, the finisher should observe the following general rules: Don't make the filler too heavy; it should have enough fluidity to sink to the bottom of the pores. Stick to one brand of filler and mix it the same way every time for any certain wood. Allow plenty of drying time; the two types of paste filler are commonly described as 4-hour and overnight-dry, but it is advisable to increase these minimum schedules by about half. Don't worry about a special type of filler for use under lacquer. If the filler has been made within the last two years, it will be formulated for compatibility with the lacquer finish as well as synthetic or varnish.

Lattice-Type Step Stringers Are Neat and Save Material

Instead of using heavy stock for stringers when building wooden steps, try the type shown. They give a neat appearance, take less material and in most cases will last longer than the heavier ones. In case they



eventually need repairing, less work and money will be required, as it may be necessary to replace only one or two of the narrow strips to make a good repair. Any kind of 1-in. wood strips 2 or 3 in. wide can be used. If the steps are to be more than 2½ ft. long it is best to use a support at each end and one in the center. Give the supports two or three coats of paint and then nail them in place, using a stone or brick foundation to support the lower edges. Apply the treads and risers in the usual manner.—F.P.Schofield, Ardsley, Pa.

Game Hooked to Hunter's Belt

Ordinary shower curtain hooks, with one end sharpened, are handy for carrying birds, rabbits and other small game. With the hook slipped through your belt loop, the sharpened end holds the game without danger of losing it. Some hunters consider this method superior to the use of game pockets in a hunting coat.

—George Bacon, Stevens Point, Wis.

Realistic Winter Scenes Between Window Sash

Evergreen branches and other greens used in decorating windows during the yuletide will not only stay fresh longer if placed between the storm and window sash, but they can be arranged to produce realistic winter gardens and landscapes. One of the simplest ways of decorating a window is to frame it with evergreen branches, using a length of light wire and giving it a couple of turns around each branch to hold and keep them spaced. The wire then is tacked to the storm-window frame. With just a little more work, a novel evergreen-forest scene can be created by using a small birch or pine log, with attractive bark, to hold the evergreen branches vertically as shown at the left. The log is flattened on one side to keep it from rolling and holes are drilled in the upper side to take the branches, which are arranged at different heights to resemble a forest. A winter landscape that is still more interesting can be created as shown in the circular detail. Here layers of white cotton are used to



produce snow banks at the ends of the window with a valley between them. A cardboard road can be made to run diagonally through the valley. Small figures of paper or wire dressed in bright scraps of cloth and engaged in skiing or tobogganing add life to the scene. Small branches of evergreen stuck in the cotton simulate trees, and there may be room for miniature cardboard houses with colored cellophane windows and lights inside.

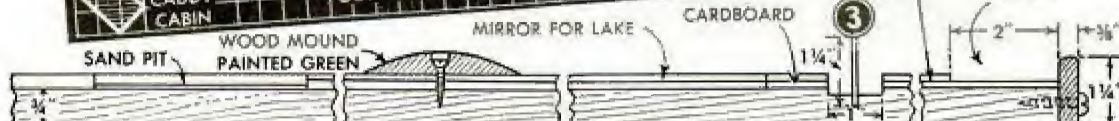
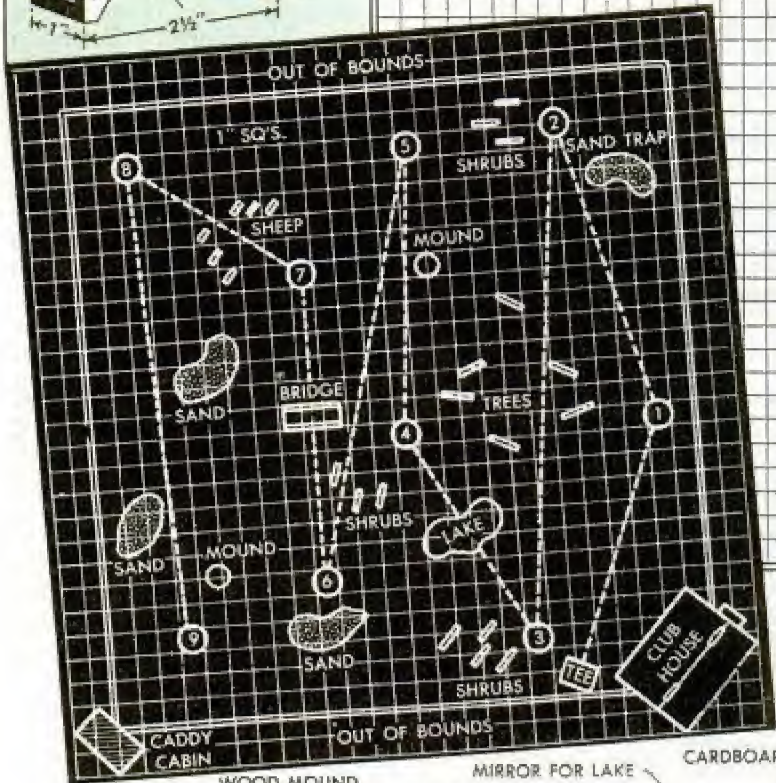
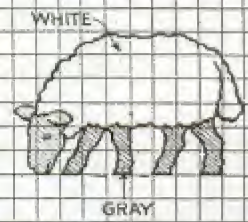
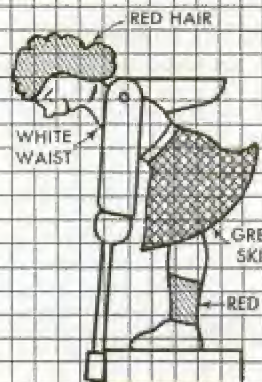
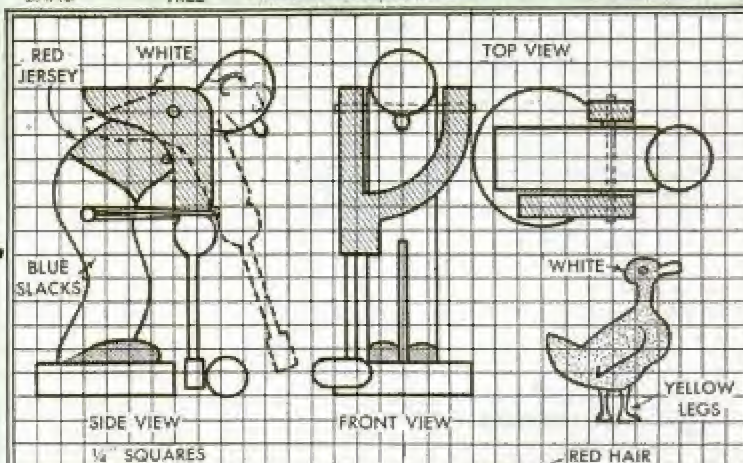
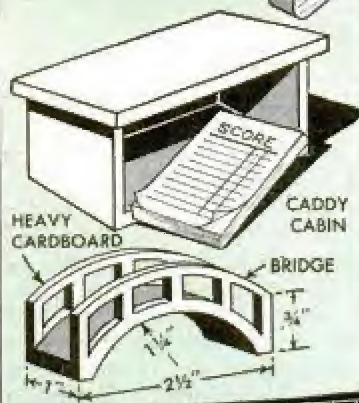
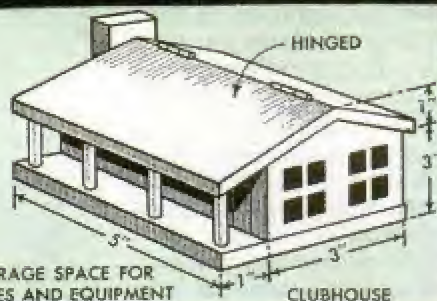
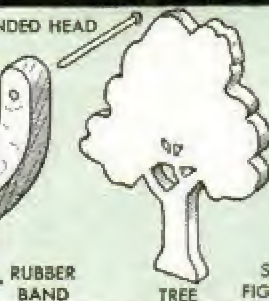
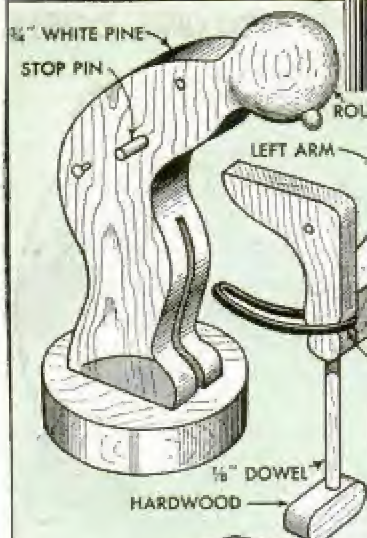
Novel Greeting Cards Produced by Perforating the Designs

Greeting cards that are decorative and unusual in appearance can be made by perforating them with a small punch to expose

different colors of paper underneath. The simple design on the Christmas card illustrated is a good example. Here a novel effect was produced by perforating the name in the card, and also by perforating the tree design to simulate lights and a star, after which an underlay of red paper was glued behind the card to show through the perforations. A star cutout at the tree top was underlaid with gold foil. Different colored lights could be simulated on the tree by first making only a few perforations and then adding the red paper, after which more perforations are punched through the card and red paper to expose still another color of paper and so on as different colors of paper are added.



PLAYING GOLF



on a Card Table



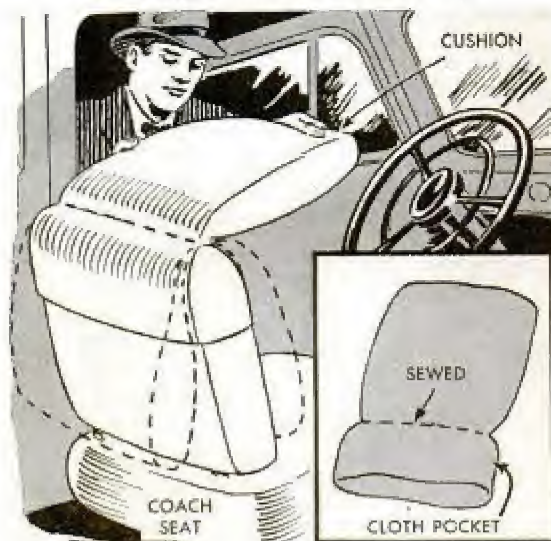
Miniature nine-hole course entertains young and old; takes little storage space

MANY hazards in this novel table-top golf course make hole-in-one shots almost as difficult and exciting to score as in the real game. It is played according to standard rules, using a small marble for a golf ball, which is driven by a club held by a "golfer" and manipulated by a player. The course is built on a wooden base to fit the top of a card table and has a hinged-roof clubhouse in which playing equipment is kept when the game is stored away. If plywood can not be had, any $\frac{3}{4}$ -in. scrap wood, glued edgewise, will do for the base, as it is covered with heavy cardboard, such as sign-writer's stock. Glue and tack this to the base and lay out the nine holes on it according to the plan view. Each hole is bored $\frac{1}{4}$ in. deep with a sharp 1-in. bit, after which the "mirror" lake and "sand-paper" traps are set-in flush. The strip around the edge of the base can extend below the edge also to keep it from shifting on the table. Green desk-blotter stock is

used for the fairways and greens and is cut to leave a 2-in. out-of-bounds margin all around. Use rubber cement, or glue, sparingly, to stick it to the cardboard, then cut the holes neatly with a razor blade and give the lake an irregular shoreline.

Both man and woman golfer are made the same way, the right arm of each extending to provide a lever to swing the club. In use, the golfer is held down with the thumb and second finger while the forefinger depresses the lever, pushing the ball rather than striking it. A rubber band, stretched from the arm to a nail in the body, improves control in putting. Make two of each golfer for a foursome and paint each differently for identification. Scroll-saw the trees, shrubs, sheep and geese from $\frac{1}{4}$ -in. wood, and paint the caddy cabin and clubhouse white with red roofs. Tee markers are metal disks soldered to wires.

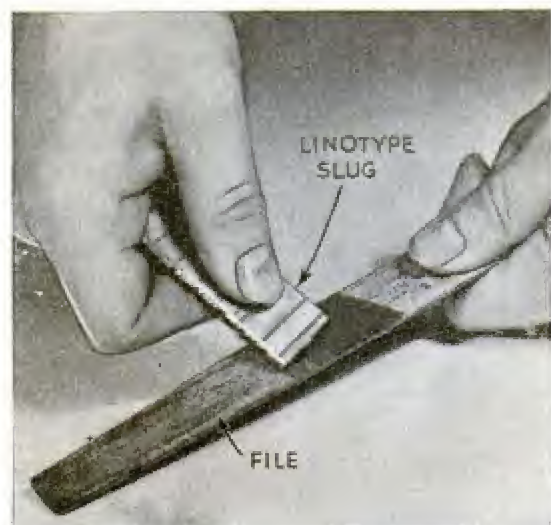
Back Cushion Used by Car Driver Swings Out of the Way



If the front seat of your car has a divided back, and you like a cushion for your back at times, sew a cloth pocket to the upper end of the cushion. The pocket can be slipped over the back of the seat to keep the cushion in place, and will permit it to be swung over the seat out of the way when not in use.

Dirty File Teeth Cleaned Easily With Linotype Slug

A linotype slug, which can be obtained at almost any printing shop, makes a satisfactory substitute for scraps of copper, commonly used to clean files. The file is permitted to rest on a bench top while being held firmly with one hand as shown. The other hand is then used to draw the slug across the file while downward pressure is being applied to scrape particles of metal out of the teeth.



Easily carved in soft pine with a jackknife

By E. J. Tangerman

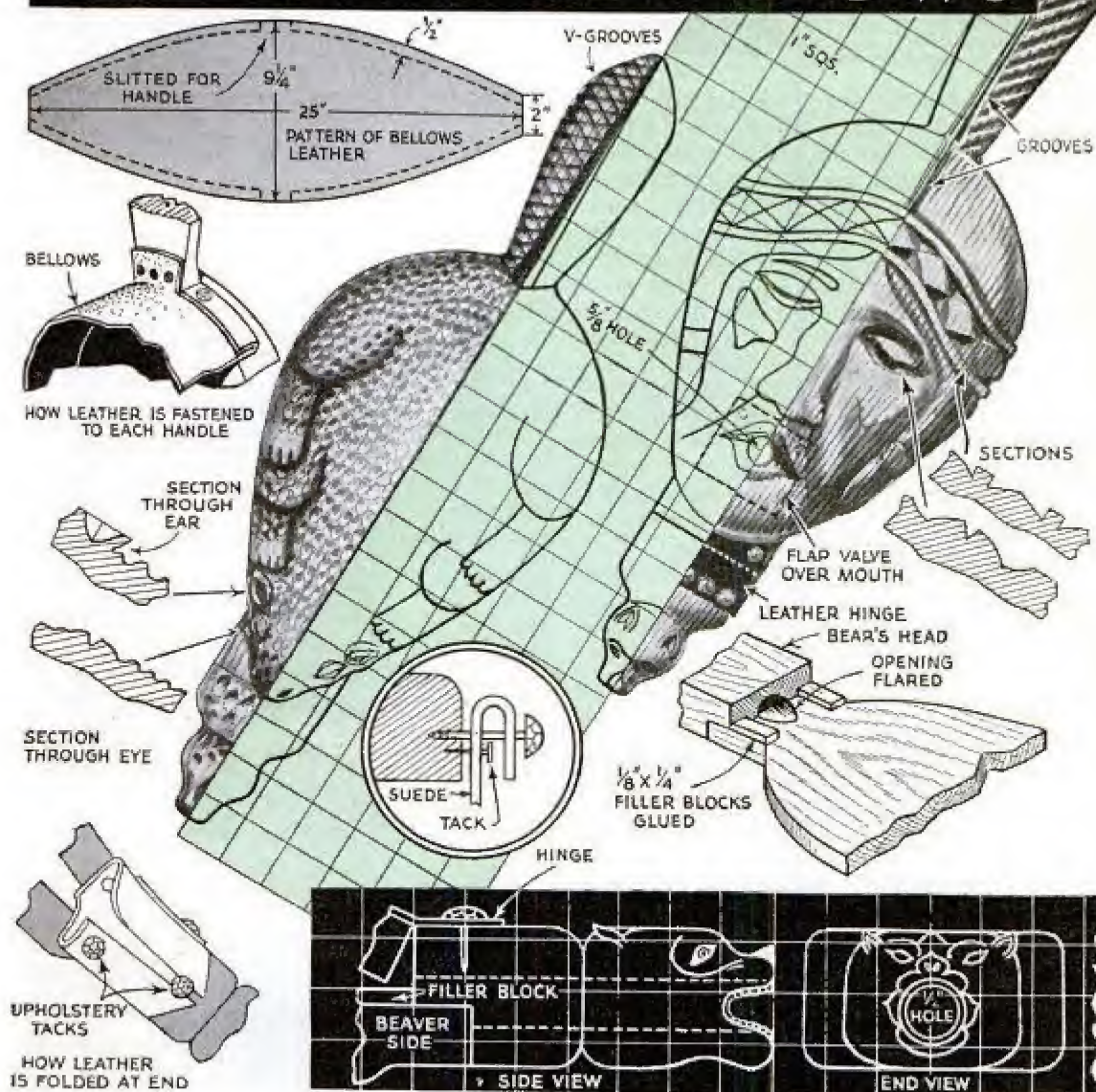
REMINISCENT of colonial days, this novel bellows with its carved Indian head and beaver pelt is especially in keeping with a colonial fireplace. The design incorporates the beaver's tail and the head-dress feather as handles, and the Indian's mouth is puckered to appear to be blowing although the air actually comes out through the mouth of a carved bear head fastened to the lower end. Both sides of the bellows are cut practically alike, the Indian side being a little wider at the neck and the pelt side about $\frac{1}{2}$ in. longer to stagger the hinge joint and also to extend into a rabbet cut in the bear's head. A piece of 1 by 8-in. white-pine shelving is excellent to carve the sides from and if it contains a knot or two, so much the better. Both feather and tail are tapered from the center to the sides and all other edges are rounded. A $\frac{5}{8}$ -in. hole forms the Indian's mouth, or air inlet, and is covered on the back with a flap valve which is simply a square piece of thin leather tacked to the upper lip with two tacks. The hole through the bear's head where it joins the sides should be hollowed out or flared as shown in the detail to assure a good entrance to the outlet.

Carving is done in very low relief, consisting largely of V-grooves made with a pocket knife. Rib cuts in the feather, the markings on the tail and toes and the eye openings are made smaller than the other cuts. The photo and sectional details will show you the right contour to duplicate. Fur is simulated on the beaver pelt by countless small gouge cuts made over the whole surface, except the paws. To compensate for the two small filler blocks glued to each side of the flared opening, the Indian's neck is whittled down at this point to fit flush with the bear's head.

Suede is best for the bellows, but imitation leather or canvas, if available, can be used, although the latter will have to be sealed with paint or oil. The details show how the leather is tacked to the sides and handles with plain tacks spaced 1 in. apart, after which the edges are folded back about $\frac{1}{2}$ in. or so and held with ornamental upholstery nails spaced about 2 in. apart.



Carved FIREPLACE BELLOWS



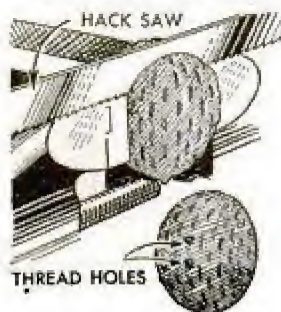
Close Control of Water Heater By Using Forced-Air Draft



If you heat your water with a pot-type stove or laundry stove and have had trouble keeping the fire controlled satisfactorily, or have to burn fuel that is too expensive or not now available, you can install a blower to provide forced-air draft, which will control the fire automatically and permit burning inexpensive fuel. All you need is a 6-volt auto defroster blower, a bell-ringing transformer and an aquastat. The installation is made as shown in the details. If you already have a transformer to operate your doorbell, current for the blower can be taken from the transformer without disconnecting it from its present circuit. If desired, a small 110-volt blower can be used by wiring a relay in the 6-volt circuit in place of the small blower. The relay then is controlled by the aquastat and in turn acts as a switch to control the 110-volt blower. With this latter installation, one side of the 110-volt blower circuit is wired through the relay.

—Austin N. Cranfield, Oceanside, N. Y.

Buttons From Black Walnuts



Attractive buttons for a sweater, a heavy sport dress, or similar garments can be made from black walnuts. After matching the walnuts for size, a side is cut from each one with a hack

saw. To do this, grip the walnut in a vise so that it projects from the ends of the jaws. If the nut is placed correctly, the ends of the jaws can be used as a guide for the saw blade. Then, dress down the edge of the sawed-off section with a file to the desired shape and size. Also, file away the rough ridges from the outer surface, remove the kernel partitions, and drill two small holes for attaching the button. Finally, scrub the surface with a rough brush to bring out the rich brown color of the shell. Tinted buttons can be made by applying colored ink with a soft polishing cloth.

—George A. Smith, Quarryville, Pa.

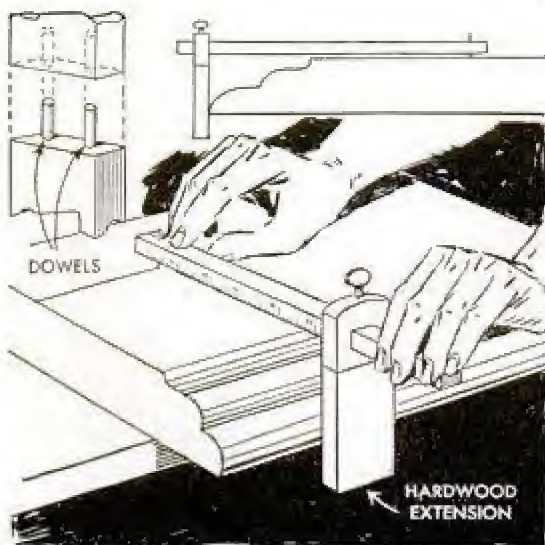
Tape-Backed Abrasive Paper Sands Scrollwork Easily

The usually tedious job of sanding scrollwork and the waste of paper can be avoided to some extent by using strips of abrasive paper backed with adhesive tape. The tape reinforces the paper so that it can be worked into the tightest places, and also makes it possible to use the paper either flat or rolled.

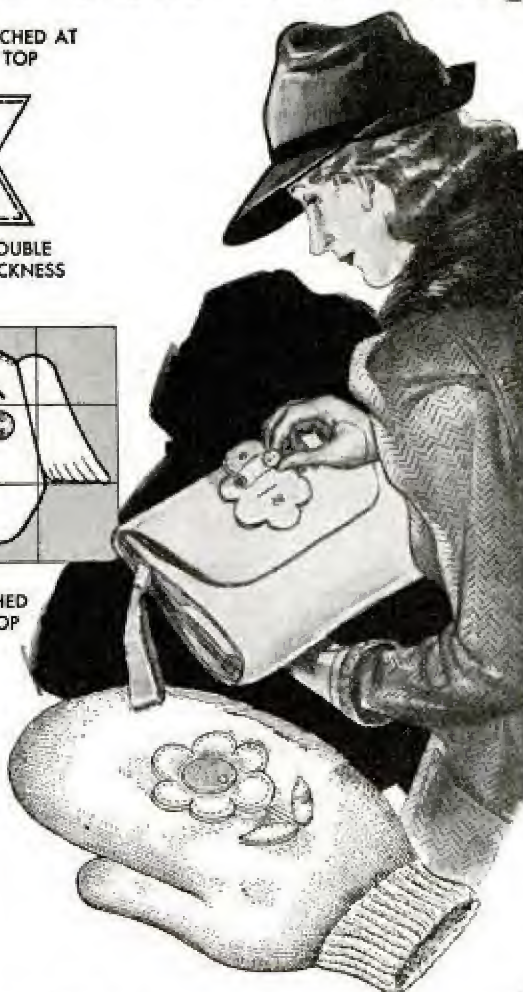
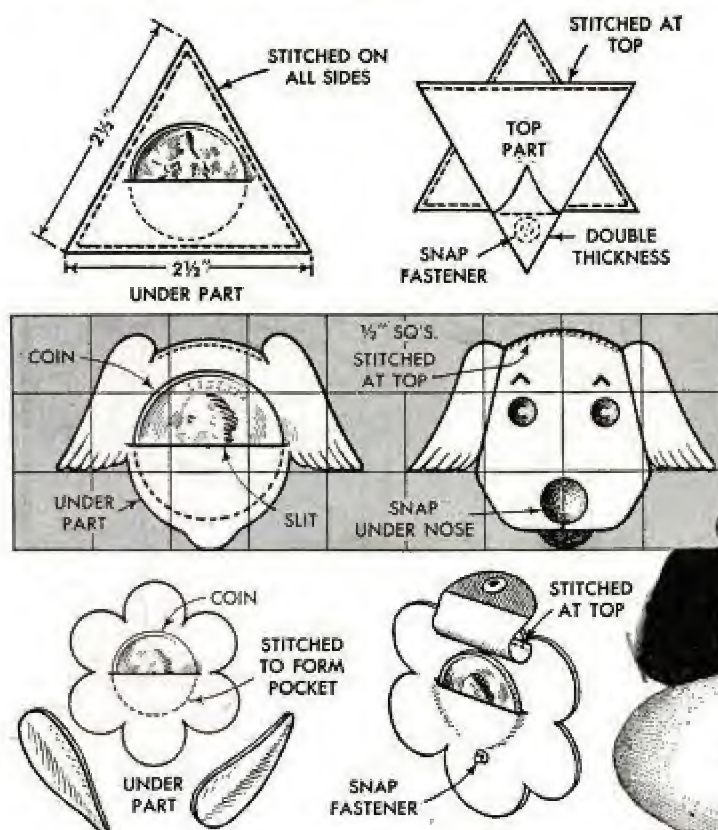


Extension on Marking-Gage Slide To Scribe Irregular Work

One carpenter who wanted to use a marking gage on thick work that had a molded edge similar to that shown, put a hardwood extension on the gage slide so that it would reach to the lower surface of the edge. The extension can be attached easily by doweling.



Handy Carfare Pocket on Glove or Handbag



Attached to the back of your mitten, glove or handbag, one of these decorative little purses will keep coins handy for carfare or other purposes. The suggested designs appear to be purely ornamental, but each one has a coin pocket concealed under a flap that forms part of the design. Leather from old gloves, belts or handbags, or felt from a hat are the best materials, although any kind of material that does not ravel when cut is satisfactory. The star-shaped purse in the upper detail consists of two triangular pieces. One has a slot cut the size of a quarter or nickel, and is stitched on all three sides to the glove or handbag. The other piece provides the flap to cover the coin. A few stitches at the top edge and a snap fastener at the lower corner of the flap keep the purse closed securely. A

small piece of material sewed to the corner of the flap will reinforce it and provide backing for the snap. In the lower detail, the flower-design purse has the slot cut in a scalloped circular piece that represents petals, the flap being held in place by a few stitches at the top and a snap fastener at the bottom. Stems and leaves are scraps of material or yarn stitches. Light colored petals with a dark center make an attractive design. The faithful pooch shown in the squared detail has ears cut in the piece underneath with a coin slot in the center.

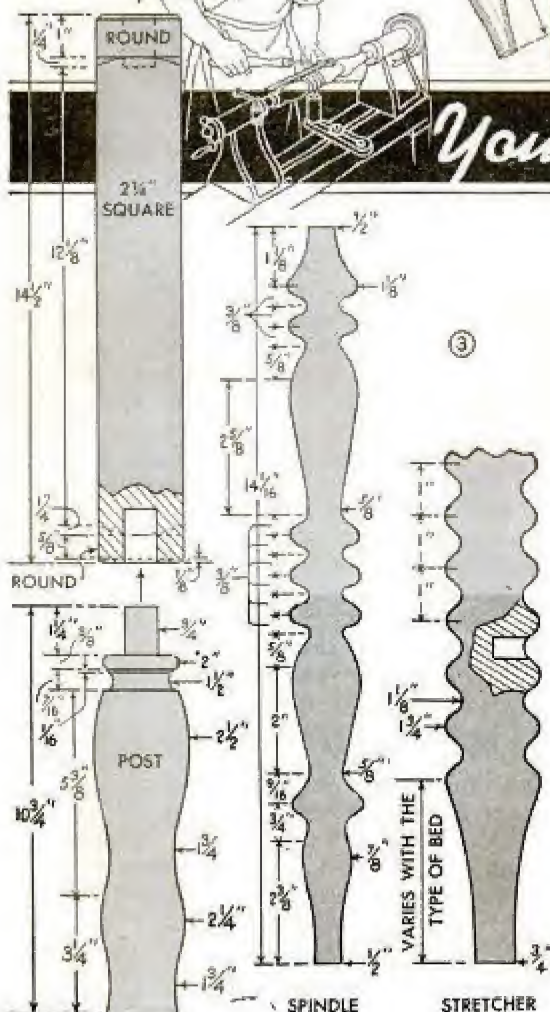
—Bess Livings Lee, Alamosa, Colo.

Automatic Stoker Powered by Gas Engine in Emergency

Our home heating plant is fired by an automatic coal stoker, which sometimes is made inoperative for hours or even several days because of severe sleet storms. To operate the stoker during such emergencies, I use a small gasoline engine. The single pulley already on the stoker motor was replaced with a double one so that the engine could be belted to the motor, run-

ning the belt out through a hole cut in the stoker casing. With this arrangement, the engine operated the stoker by merely rotating the motor. Changing from motor to engine was just a matter of putting on the belt. Of course, all automatic controls are inoperative when using the engine, which must be controlled manually.

—John W. Belsley, Morton, Ill.



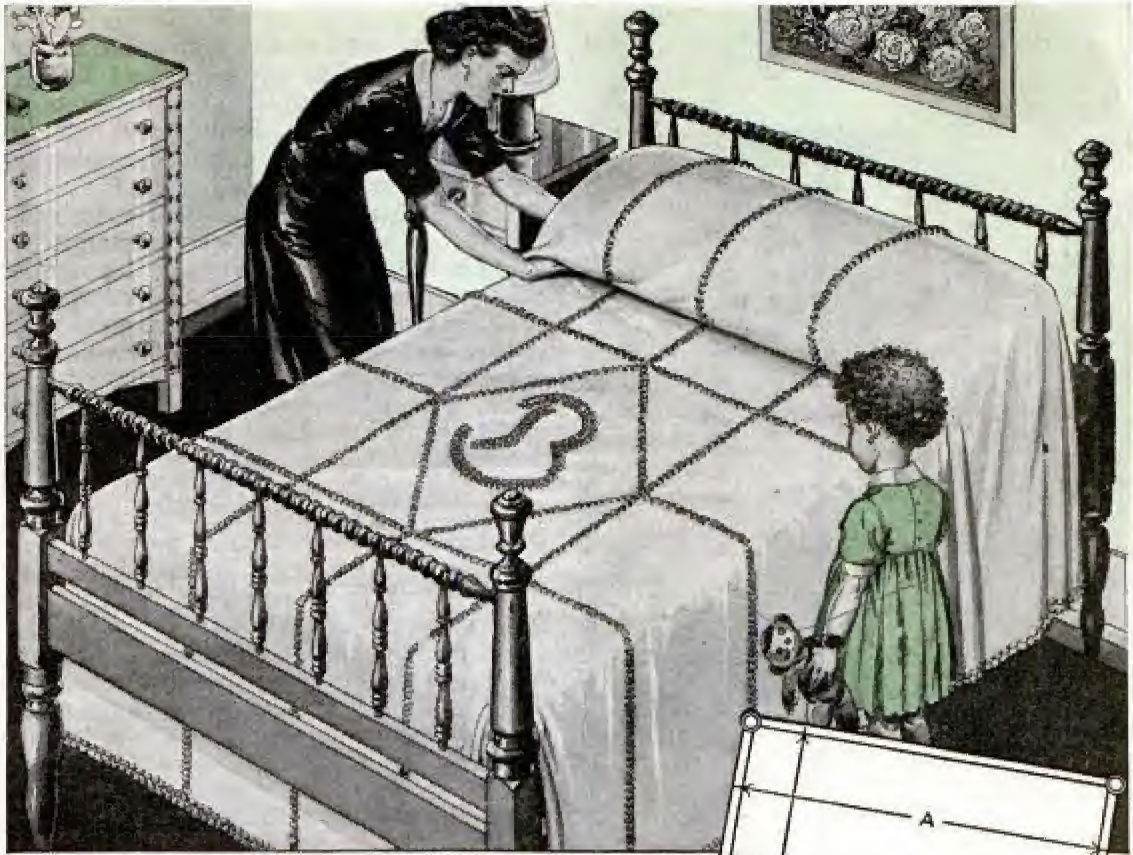
You Can Turn This

Simplified adaptation of Jenny Lind style—a good lathe job for beginners

By Wallace W. Buffmire

CHARMINGLY quaint in ruddy maple, this colonial four-poster bed also works up beautifully in walnut or mahogany. Except for mortising and tenoning the rails, the whole job can be done in a lathe. Construction is practically the same whether the bed is a single, twin, three-quarters or full size, only the number of spindles varying with the width. Fig. 4 gives the width for standard springs of the four sizes. The type of spring used will determine whether bed slats are needed, as some springs are made to rest on top of the rails.

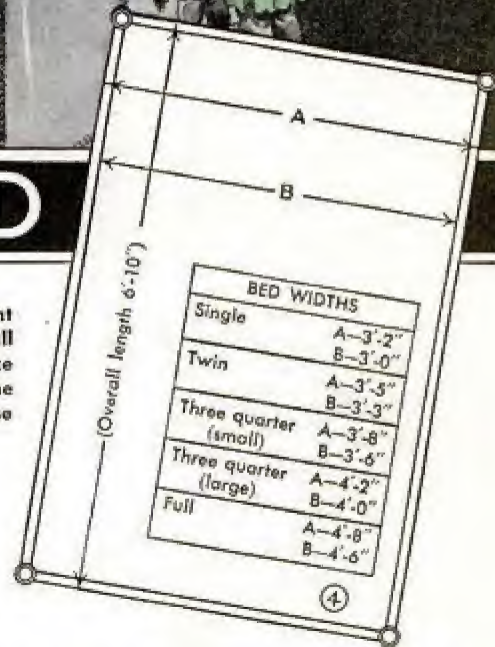
Each post is made up of four sections as detailed in Fig. 3. However, if the capacity of your lathe permits, the two center sections can be turned in a single length of 2¼-in. square stock and the top and bottom sections turned separately and doweled to it. Solid turning squares are best



COLONIAL BED

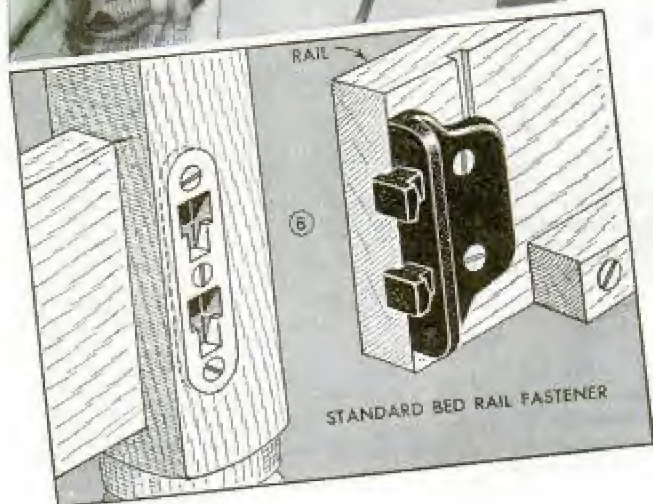
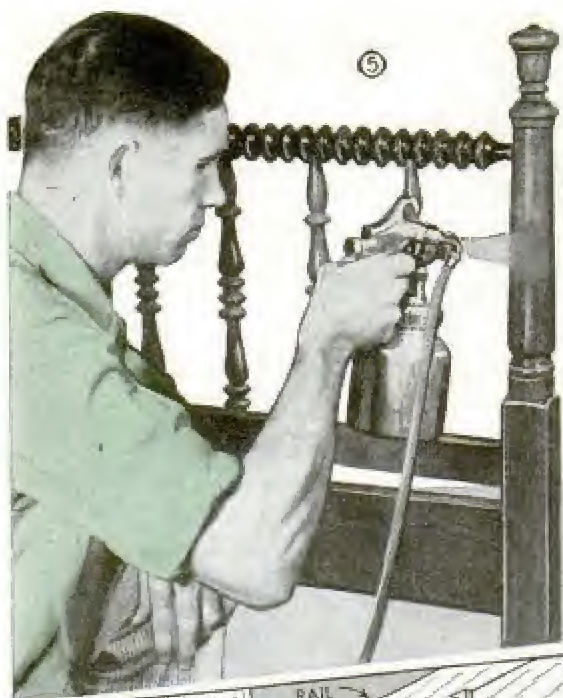
for the posts, but where these cannot be had, built-up stock will do, providing the pieces are properly jointed and a good resin-type glue is used. It is best to bore the holes for the stretcher tenons while the work is square, especially so in the case of the stretcher itself, Fig. 1. In turning each post, as well as all other duplicate parts, try to match each one as closely as possible, using calipers frequently to check the work at respective points. A jig consisting of a wooden strip having brad points projecting from one side and spaced to correspond with the drawing, will serve as a master pattern to use in marking off duplicate turnings lengthwise. If the posts are made in four sections, care must be used in centering the holes in the ends of the square sections, so that adjoining parts will be in alignment. Fig. 2 details how the end rails are cross-pegged in mortises cut in the posts. The narrow rail above it is about $1\frac{1}{2}$ in. wide, and is pegged in the same way. In the case of the two front posts, the holes for the pegs should be made blind so that the dowels will not show on the face of the post.

While the chart at the right gives both inside and overall widths of five standard-size beds, it's best to measure the spring which you plan to use



Both head and foot are exactly alike. In assembling each one, glue the spindles to the stretcher and narrow rail first, then glue this to the posts as a unit at the same time the end rail is fitted. There are various type bed-rail fasteners available, one of which is shown in Fig. 6. In fitting them, locate the socket part on the posts to bring the top of the spring about 18 in. above the floor. The spring should be at hand in determining this as it will make a difference if the spring sets inside the rails.

The finish to apply depends upon the effect desired and the kind of wood used. Whether stained or left natural, walnut and



mahogany require a paste filler to fill the pores of the wood, over which a thin sealer coat of shellac is applied, then lightly sanded and followed with several coats of high-grade varnish. Filling and wiping all turnings can be done conveniently while they are in the lathe. In fact, if a French polish of shellac and oil is desired, the turned work can be completely finished in the lathe. In following this method, you must be careful to see that tenons are kept free of shellac to assure good glue joints. If spraying equipment is available, a satin-sheen, lacquer finish can be applied. Here the work is filled as before and a coat or two of lacquer sanding sealer is applied as in Fig. 5. Because of the light body of a clear lacquer finish, it is important that the pores be filled perfectly flush. If upon close examination they are not completely filled, apply a second coat of filler. When the sealer coat is dry, it is sanded lightly with 7-0 paper, then dusted and sprayed with several coats of gloss lacquer, thinned 50 percent with lacquer thinner. Undercoats of gloss lacquer are preferred in building up a good body, as they contribute to a clearer finish. A fairly good imitation of a hand-rubbed finish is obtained by using a flat lacquer as a final top coat. This dries with a soft, satin luster, requiring no rubbing. "Orange peel" texture in the finish, which results when the gun is held too far from the work, or when the air pressure is too low, can be corrected to some extent by spraying the final top coat lightly with plain lacquer thinner. This has been found effective in leveling off the pebbled coat.

Barbs in Chisel Ferrule Embed to Hold Handle Securely

Annoyed by having the ferrules of a set of wood chisels become loose on the handles, I corrected the trouble by peening or notching the inner edges of the ferrules with a cold chisel as indicated. Tiny prongs or barbs formed by this procedure became embedded in the wood when the handles were forced into place to hold them securely.—G. E. Hendrickson, Argyle, Wis.

Window Streaks Located Easily

When washing windows it is a good idea to dry them on the outside by stroking the cloth up and down, and on the inside by stroking the cloth horizontally. Then, if there are any streaks you can tell at a glance whether or not they are outside or inside the window.

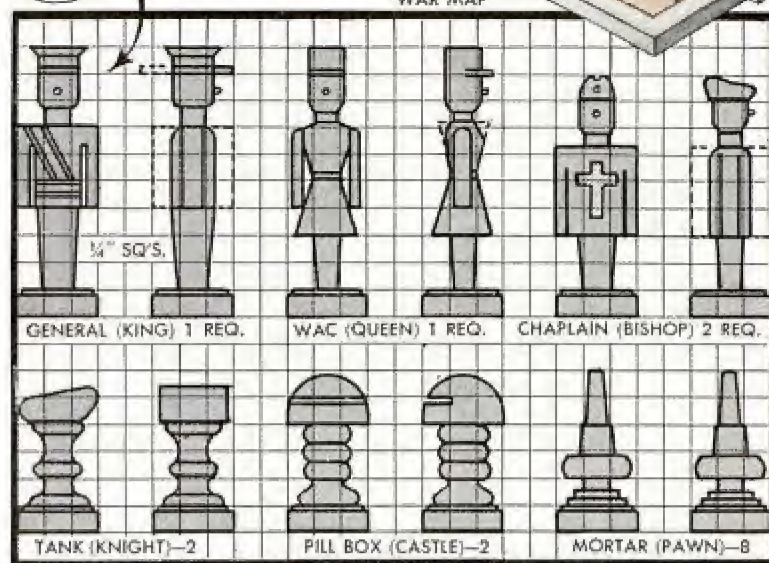
—Benj. Nielsen, Aurora, Nebr.



Military Chessmen Maneuver on "War Map"



HOW WAC IS TURNED AND CARVED



Chess "goes to war" in the form of a novel military set, which is played in the usual way but on a map "battlefield" with army figures representing king, queen, bishop, etc., of a regular set. A complete set totals 32 pieces. One set of 16 is turned in walnut or other dark wood and a duplicate set in a contrasting wood, such as maple. The general, WAC and chaplain are carved as indicated after turning. The playing board consists of a colored map glued to plywood and covered with celluloid which is ruled off in squares and painted with transparent colors to produce a checkerboard

Sleet on Windshield Removed Quickly With Anti-Freeze

When parked during a rain or sleet storm at nearly freezing temperature, and you find your windshield coated with ice, you can remove it quickly to permit clear vision by applying some anti-freeze solution of the kind having an alcohol base. This will be convenient if you are using such anti-freeze in your cooling system, since it is a simple matter to dip a rag in the radiator and then apply it to the ice. However, in doing this, care must be taken to avoid getting the solution on the finish of the car, as this may be attacked by the alcohol.

❏ Add water through the spout of a hot teakettle instead of removing the cover which may allow steam to burn your hand.



Scraper to Bare Insulated Wire Closes Like a Jackknife



You'll find this scraper very handy for removing insulation from wire, and it can be carried in your pocket just like a jackknife. The two blades are broken from the ends of an old hacksaw blade so that the two holes can be used in pivoting them to a handle. This is shaped from a small wood block as indicated, the blades being pivoted in the handle with their toothed edges facing so that good scraping edges are provided when the blades are opened to a V-shape.—R. Eyrich, Milwaukee, Wis.

Chessmen Improved by Weights Placed in Their Bases

An ordinary set of chessmen having large bases can be improved by weighting them with lead or linotype metal, the latter being available in small amounts from



most print shops. To apply the weights, first put each chessman into a well-padded vise and bore into the base with a $\frac{3}{16}$ -in. drill, being careful not to cut too deeply. Mark the drill for depth with a narrow strip of tape. To obtain uniform weight, all the holes should be the same depth, and they must be undercut to anchor the metal. This can be done with a tool shaped like the one shown. The main thing about the undercut is to have it square at the bottom to avoid up-and-down play of the metal. After melting the metal, pour it into the holes and when it has hardened, glue disks of leather or felt to the bottoms of the chessmen. Kid from a lady's old glove is excellent for the purpose. Before gluing on the disks you may care to refinish the men by polishing them with rottenstone and felt, repainting if necessary, and then varnishing them.

—A. D. Pitney, Chicago.

Bottle of Charged Water Used As Small Fire Extinguisher

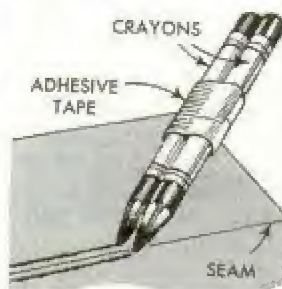


A bottle of charged water, such as is used for mixing beverages, provides an emergency fire extinguisher if it is fitted with a short hose and nozzle. You will find that pressure inside the bottle is sufficient

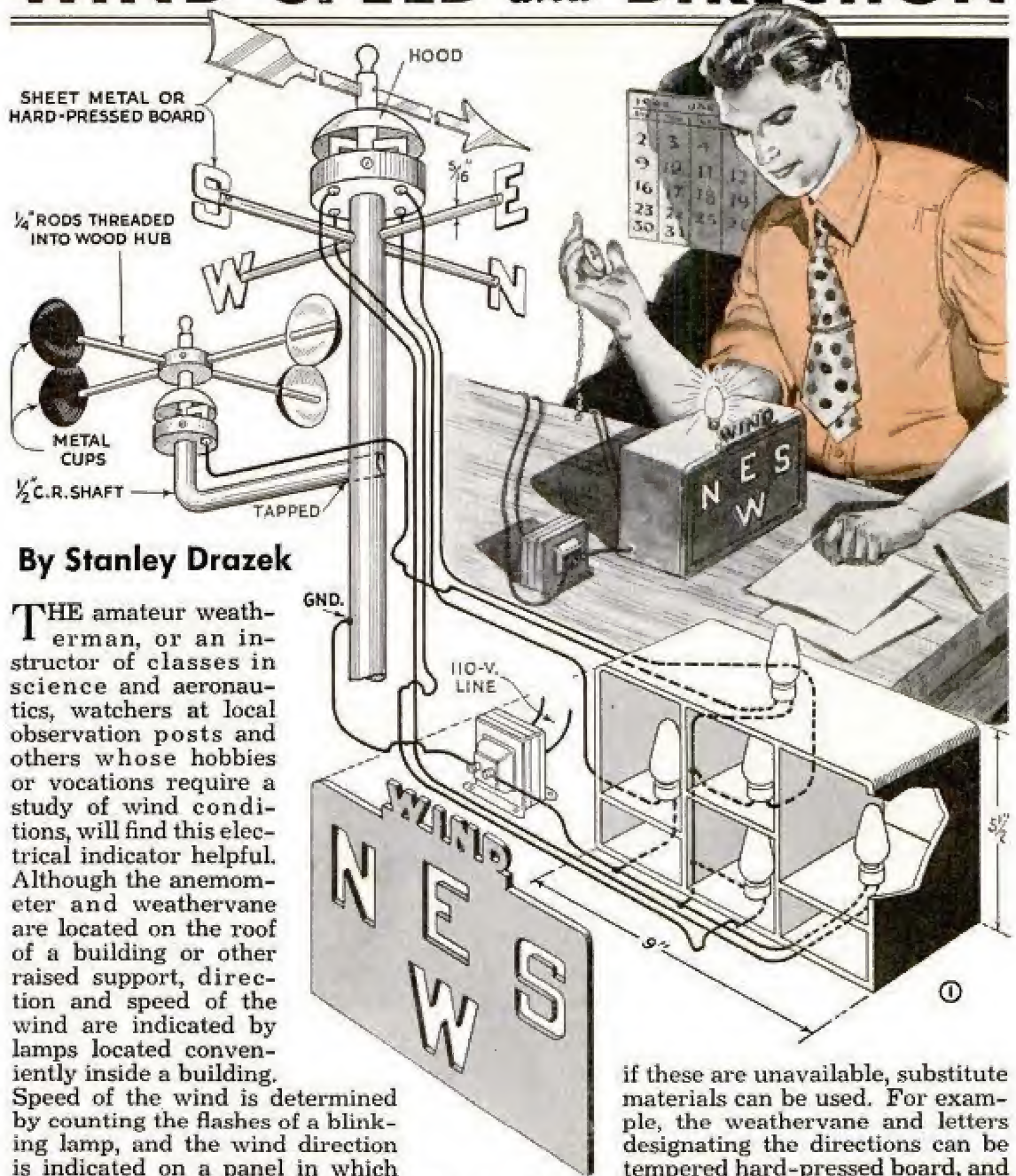
to throw a stream of water nearly 30 ft. The quart size bottle of water is sufficient to extinguish most small blazes when used properly.

Crayon Marks Confine Solder To Sheet-Metal Seams

Beginners who experience difficulty in confining solder to a narrow, neat band when making long seams in sheet metal, will find that a grease-crayon mark on each side of the seam will do the trick. The solder will not flow beyond the marks unless an excessive amount is used, in which case it can be removed easily, as solder will not adhere to the metal under the marks. By taping two crayons together, a line can be made on each side of the seam in one operation.



Electrical Indicator Blinks WIND SPEED and DIRECTION



By Stanley Drazek

THE amateur weatherman, or an instructor of classes in science and aeronautics, watchers at local observation posts and others whose hobbies or vocations require a study of wind conditions, will find this electrical indicator helpful. Although the anemometer and weathervane are located on the roof of a building or other raised support, direction and speed of the wind are indicated by lamps located conveniently inside a building. Speed of the wind is determined by counting the flashes of a blinking lamp, and the wind direction is indicated on a panel in which the letters N, E, S and W are jigsawed. A lamp behind each letter lights up whenever the weathervane, which acts as a switch to close the electrical circuit, points in the direction designated by one of the letters.

Although construction of the indicator may seem difficult at first glance, it is quite easy. Naturally, steel shafting is best for the main standard and the arm supporting the anemometer, and brass or copper is best for the rest of the exposed parts, but

if these are unavailable, substitute materials can be used. For example, the weathervane and letters designating the directions can be tempered hard-pressed board, and the small rods supporting the letters and also the anemometer cups can be hardwood dowels. Also, it is possible to use wood for the standard and arm. If this is done, short shafts must be inserted in their upper ends to provide bearings. And, of course, the short rotating shafts of the vane and anemometer must be metal to withstand wear. If regular spun-metal wind cups for the anemometer are unavailable, the bowl parts of large spoons will serve, but they all must be of the same size and shape.

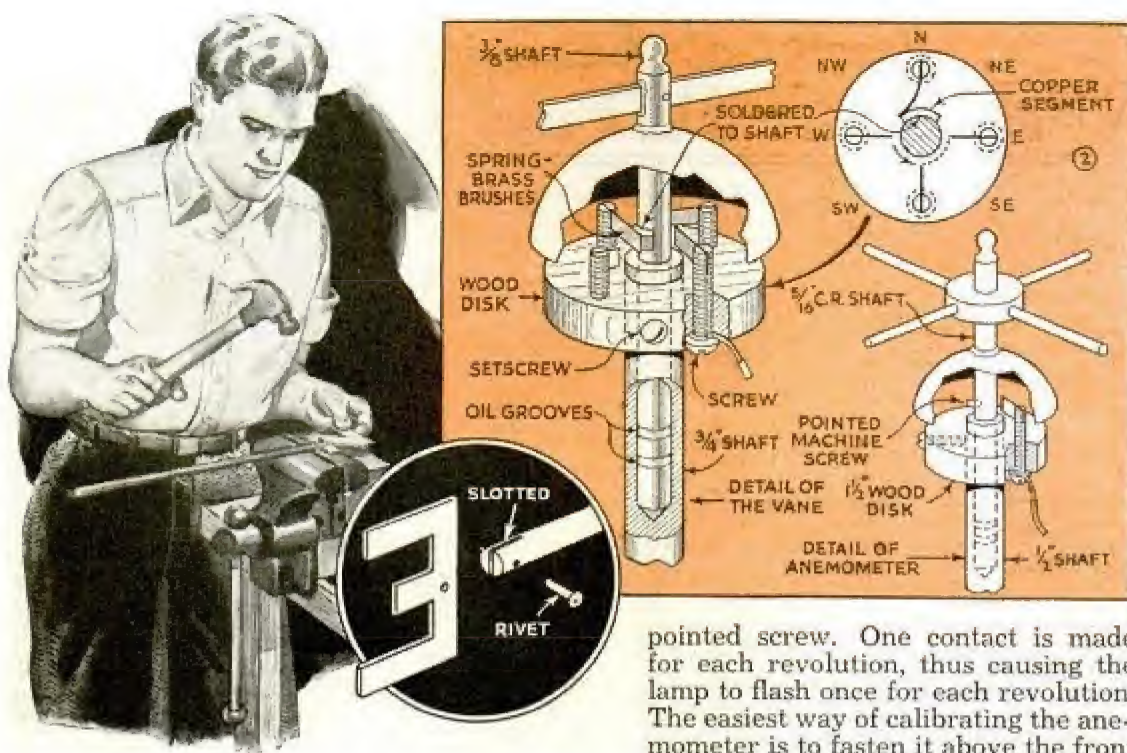


Fig. 2 shows how the pointed shafts of the anemometer and weathervane work in the drilled ends of their standards to reduce friction to a minimum. Notice that grooves near the lower ends of the shafts serve as oil reservoirs, which make frequent lubrication unnecessary. Reference to the left-hand detail of Fig. 2 will show you how to construct the weathervane brush assembly, which consists of four brushes mounted on a wooden disk, the latter being locked on the upper end of the standard with a setscrew to permit adjustment. The brushes are strips of spring brass or copper clamped in the slotted ends of screws turned up through the disk. The brushes make contact with a single-segment commutator sweat-soldered to the vane shaft. It is very important that the segment width be equal exactly to one quarter of the vane-shaft circumference, and that the segment center be exactly in line with the vane. In this way, when the indicator is wired as in Fig. 1, only one lamp will show on the indicator panel when the vane points north, east, west or south, as the commutator contacts only one brush. But, if the vane points between two of these directions, the brush will contact two adjacent brushes and two lamps will show. For example, a northeast wind would cause the north and east lamps to show. A sheet-metal hood protects the brush assembly.

Construction of the anemometer mounting and brush assembly are similar to that for the vane, except that only one brush is used, and the commutator consists of a

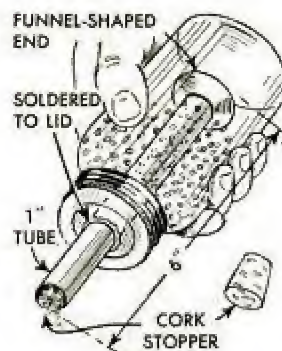
pointed screw. One contact is made for each revolution, thus causing the lamp to flash once for each revolution. The easiest way of calibrating the anemometer is to fasten it above the front of a car and drive on a calm day, counting the revolutions of the anemometer at various speeds. This data is recorded on a scale, which is placed near the indicator to aid in computing the wind speed by anyone counting the flashes of the lamp for 1 min. Electric current for the indicator is supplied by a 6-8-volt transformer, and Christmas-tree bulbs and sockets are used for the lamps at the indicating panel.

Handy Dispenser From Fruit Jar

Where small, measured amounts of materials, such as tea, coffee, soap flakes, etc., are to be poured from containers, this easy-to-make dispenser will come in handy, as all you have to do is tip it upside down to

pour out the predetermined amount. A fruit jar is used and the lid is fitted with a tube as shown, the lower end of which is provided with a concave or cupped piece of tin of a size to hold the desired amount of material to be dispensed.

When the dispenser contains a material from which air should be excluded, a cork can be inserted in the end of the tube and a rubber can be used under the jar lid.



Improved Stopper for Ink Bottle

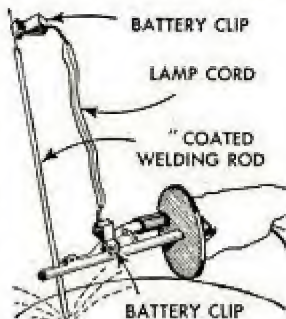


in its place. The surface of the disk must be flat and smooth to make a good seal.

Jumper Wire Makes It Easy to Use Long Thin Welding Rods

Long thin welding rods of the coated type that have to be clamped in the torch at one end often have a tendency to vibrate and make it difficult to strike an arc. To avoid this trouble, I use a jumper wire which is fastened to the torch and to the end of the rod by means of battery clips. With this arrangement, the rod can be gripped in the torch close to the lower end and thus eliminate vibration. The jumper is made either of heavy insulated wire or from three or four lengths of lamp cord having the ends bared and soldered together to produce a cable heavy enough to carry the required current safely.

—Fred Pinkus, La Crescenta, Calif.



Valve Balls Cleaned in Bottle



Cleaning and polishing of ball bearings and brass balls used in certain types of valves can be done easily by using a bottle. This should have a mouth slightly smaller than the diameter of the ball to be cleaned. Fine valve-grinding compound is applied around the edge of the bottle mouth, after which the ball is rotated against it with the palm of the hand.

Rotating Offset Anchor Stake Loosens It for Pulling



Steel stakes used to anchor power windlasses and other heavy machines usually must be driven into the ground so firmly that they are difficult to remove without some special pulling device. However, if the stakes are offset near the top as shown, they can be rotated to loosen them even in the hardest ground, and thus facilitate their removal.

Posthole Auger Cleaned Easily On Portable Knocker

Having a number of postholes to dig in clay soil, which was difficult to remove from the auger, one farmer used a knocker like the one shown. It is merely a disk from an old disk harrow which is fitted with a pipe tee and three nipples as indicated, the pipe assembly being locked into the axle hole of the disk with a pipe nut placed on each side.





TAKE IT CLOSE-UP *by Fred G. Korth*



TAKING a subject close-up is the secret of creating attention-getting photos and the best way to make photos tell stories. Anything not essential in a picture and which does not tend to emphasize the theme, definitely detracts from the effectiveness desired. Therefore the photographer must avoid getting too much in a picture, a common fault of beginners.

Suppose you choose the subject "Spring" for a photo, and you are walking in the woods looking for a picturesque curve in the path or for a small brook reflecting the sun and the trees. Having this in mind you are apt to include too much in the picture. So, instead of continuing with this angle in mind, just step over to one of the trees and look for a twig with some buds. Then focus on this alone. Be sure that the background does not detract and try to keep it out of focus. Snap the picture and you have your shot of Spring. What is more representative of it than buds appearing on a tender twig? Photos of this type

reveal details that the average person has no time to detect and to observe.

If you love pets, you may have taken numerous photos of them in various poses—playing, stretching, yawning, jumping and perhaps creeping up on prey. However, take a close-up as shown in Fig. 1, and everybody will notice the “soulful” eyes, the fur and the whiskers. Such a shot is one of the easiest to get and one of the best for effect. It is simply good close-up photography. Taking a photo of the whole cat would probably give the idea of “just another alley cat” but a photo of the face only avoids this impression. In this case all rules of composition seem to be violated as both halves are identical and there is



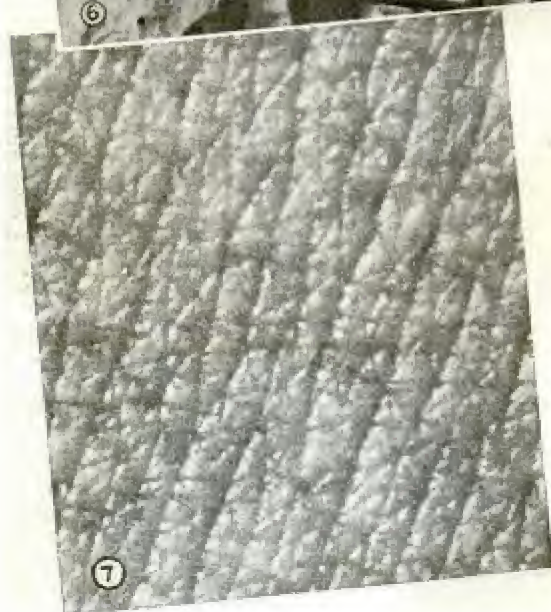
← *Wrong* ↑ *Right* ↓



Although repetition is sometimes used to emphasize, the countless spirea blooms above just convey the idea of a profusely blooming shrub—not the idea of a flower. To emphasize the latter, take a closeup of one or only a few blooms as in Figs. 3 and 5

no diagonal or S-curve; yet the effect obtained depends on the fact that much has been eliminated. Elimination of confusing masses and lines from pictures brings the observer to the point you want to stress—and in many cases the only point worth showing.

Figs. 3, 4 and 5 illustrate what to do and what not to do in getting photos of flowers. In Fig. 4, a spi-



rea bush is covered with blooms but not one can be seen well enough to be appreciated. Fig. 6 shows five roses each having distinctive lines and masses, making it possible for anyone to appreciate their delicacy. More interesting and effective however, is the close-up shown in Fig. 3, where a single chrysanthemum is pictured and only part of the flower is included. Note how the radiating lines of lights and shadows produce a pleasing effect.

Many other subjects offer possibilities for close-up photos. Fig. 2 is a shot of a 2-in. chromium-plated horse mounted on the edge of an ash tray. A piece of satin, arranged in a fan shape was used as a background. A single lamp was used to illuminate the background and no light was directed on the horse. However, the latter was kept in sharp focus while the

satin background was softened by being kept out of focus. With the same piece of satin you can produce draped effects such as shown in Fig. 8, merely by hanging the cloth over the back of a chair. One light for texture and shadows must be placed fairly close, with a second light near the camera to illuminate the cloth from the other side and to lighten up the deep shadows. Another novel experiment in close-up photography is shown in Fig. 6. Here a number of crackers were laid down like the shingles on a roof. The lighting arrangement was somewhat similar to that used for Fig. 8.

Human skin offers possibilities. Although seen constantly, every day, few people have looked at it carefully under a magnifying glass. Fig. 7 shows human skin enlarged seven times actual size. A subject such as this needs magnification to reveal the delicate texture. A camera having a ground glass and an extension bellows is needed for this kind of photography. With a bellows extension twice the focal length of the lens, you can photograph objects up to their actual size. For a double-size image you need a triple extension, and for a triple size image, a quadruple extension, etc. If your large camera has a double extension, you can fit it with the lens of a miniature camera or enlarger, which combination will enable you to get pictures of many magni-

Three examples of texture effects in closeups: Fig. 6 shows crackers arranged in shingle fashion while Fig. 7 shows a patch of human skin seven times actual size. Soft, pleasing effect of draped satin as in Fig. 8, is obtained by proper use of highlights and shadows



fications. Of course, there will be a comparatively dim image on the ground glass because the light has a longer distance to travel inside the camera and consequently the exposure must be correspondingly lengthened. For taking a picture at double extension so the image is actual size, you read the exposure meter, assuming that you are using one, at two stops smaller than for an infinity setting. For each further magnification, you double the exposure again or read one full stop smaller. For example, if you have a 4 by 5-in. camera equipped with a 2-in. lens taken from a miniature camera, and you are to take a picture of some buttons four times their actual size, you may have a normal exposure of $\frac{1}{50}$ second at stop f:11. However, due to the long bellows extension, the effective opening is five stops smaller—or f:64, requiring an exposure of $1\frac{3}{8}$ seconds. Subsequent enlargement of the resulting negative will make possible pictures of buttons more than eleven times actual size. One New York fashion house used a large photo mural consisting of just a few buttons.

Another example of close-up photography is shown in Fig. 9. To emphasize the idea of playing chess, only a few chess pieces and a hand were included. From an angle of composition, such a photo is much easier to take than one which includes the players. In cases where you use a hand in a setting such as in the chess photo, the model will be unable to hold the hand in the right position for any length of time, while you are busy arranging the lights. Therefore you should provide some kind of rest for the arm, such as a couple of books, where it will be out of camera range.

A still-life subject is shown in Fig. 10. It was arranged on the floor so that an unduly high tripod was not needed for the



Theme of Fig. 9 is "Chess Playing," brought out strongly by closeup of few pieces and hand moving queen. Photo including more pieces, background and players would distract attention and involve composition problems



Still-life taken from above was spot-lighted from side opposite camera to produce shadows in front of cookies but the use of a fill-in light below camera kept these shadows from being dense black

camera. A small spotlight was directed downward from the opposite side and a photoflood in a reflector served to light up the shadows on the lower front portion of the basket. The spotlight was equipped with a photoflood bulb to avoid a sharp spot of light. The fill-in lamp lighting the front should be made weaker than the spotlight by locating it farther from the subject or by hanging one or two layers of tissue paper on the reflector in front of the bulb. The fill-in light also must be low enough to prevent it throwing cross shadows.

Finger Marks on Paper Avoided By Using a Vacuum Cup



Unightly finger marks will not get on your photographic paper if you use a small vacuum cup to lift it from the box and place it in position for printing. For convenience, the vacuum cup is mounted on a suitable handle. After the paper is in place, a slight side motion of the hand will release the cup.

Two Clocks Serve as a Timer In the Photo Darkroom



If you use a common clock instead of an interval timer in your darkroom, it is unnecessary to depend on your memory to remove films from the developer. The end of the developing time can be indicated beforehand

on a second clock by setting the hands ahead. The second clock does not have to be in running order. Any old timepiece will do if the hands can be turned.

—J. Modroch, Danbury, Conn.

Easter-Egg Dyes Tone Photos

Easter-egg dyes provide an inexpensive and satisfactory method of toning photographic prints in different colors. The strength of the solutions used for coloring eggs usually is too strong for use as a toner, and must be diluted considerably. The diluted solutions will tone prints in about 5 minutes. If the tablet form of dye

is used, the tablet must be pulverized and dissolved thoroughly or small particles will cause spotting. The addition of vinegar, which is recommended for coloring eggs, is not necessary for toning prints.

—John Karlovic, Chicago.

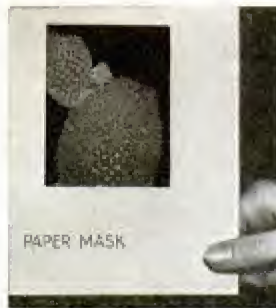
Pocket in Lid of Camera Case Carries Lens Tissues

Lens tissues always will be available if you keep them in a pocket in the lid of your camera case. The pocket can be made of cloth, Cellophane or paper, fastened to the inside of the lid with strips of tape.



Still-Life Pictures Composed With Cardboard Frame

Composition of still-life or other subjects is simplified by using a cardboard frame through which to view the subject before the picture is taken. Several frames are cut in proportion to the size of the film used and the size of the subject. By holding different frames in front of the proposed picture, you can



see just how much to take in without wasting film for trial shots. The frames are especially convenient for composing arrangements of flowers and tabletop scenes.

Photos Easily Changed in Frame When Held by Two Bow Sticks

To simplify changing photos in frames in his display case, one photographer uses thin strips of hickory instead of nails to hold the photos in place. The strips are cut a little longer than the inside width of the frames so that they will be bowed slightly when they are inserted in the frames as indicated.



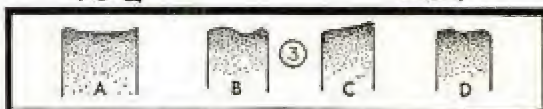
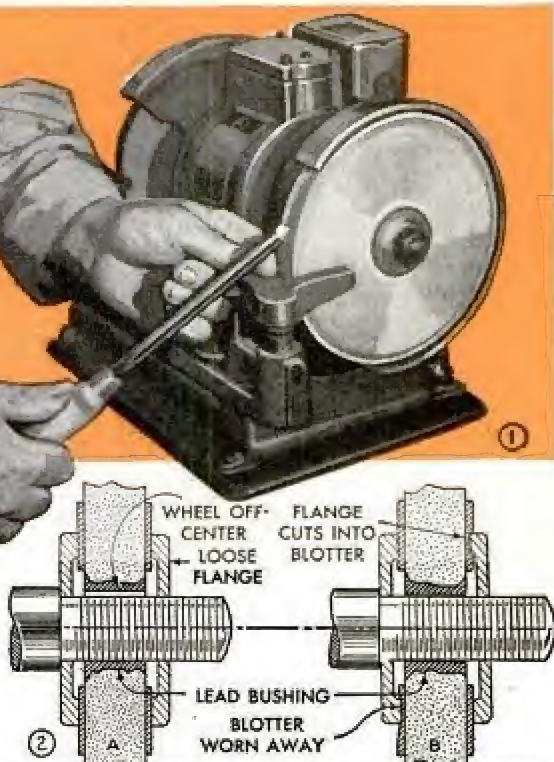


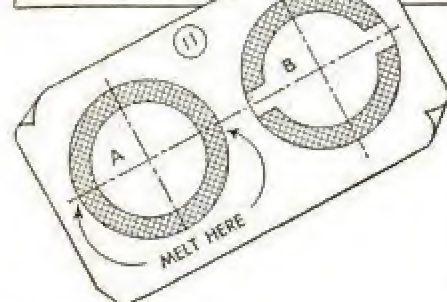
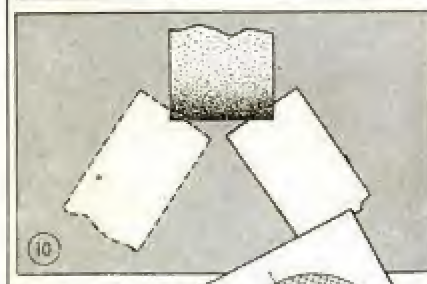
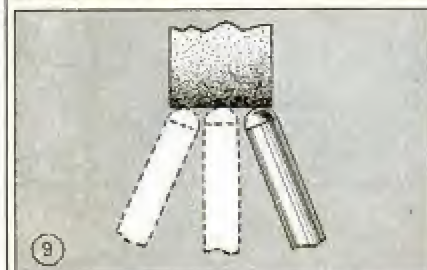
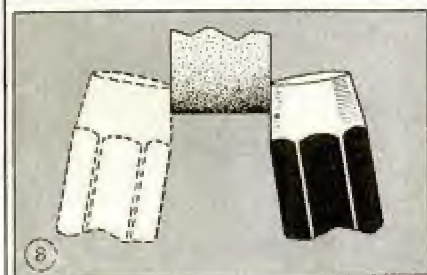
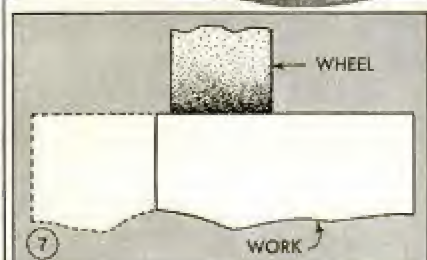
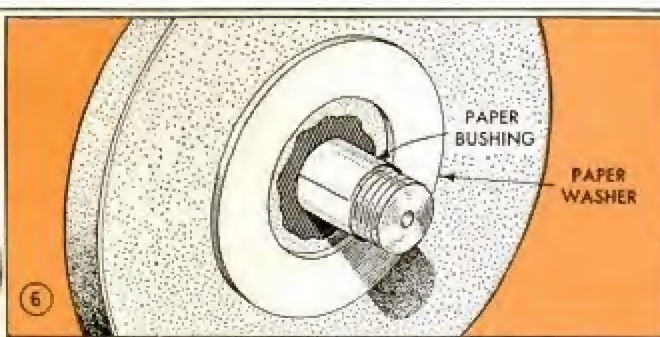
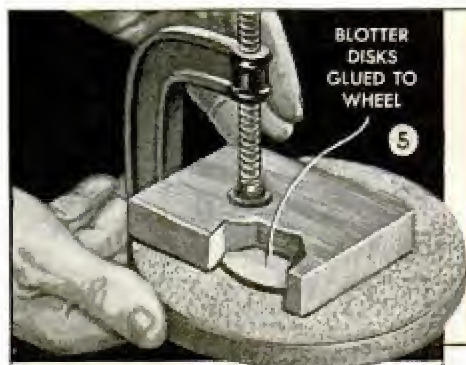
SHOP NOTES

Longer Life for **GRINDING WHEELS**

By W. C. Lammey

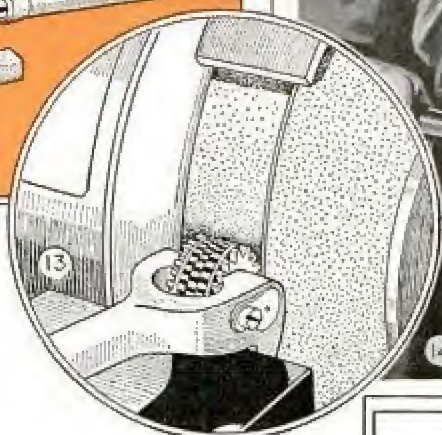
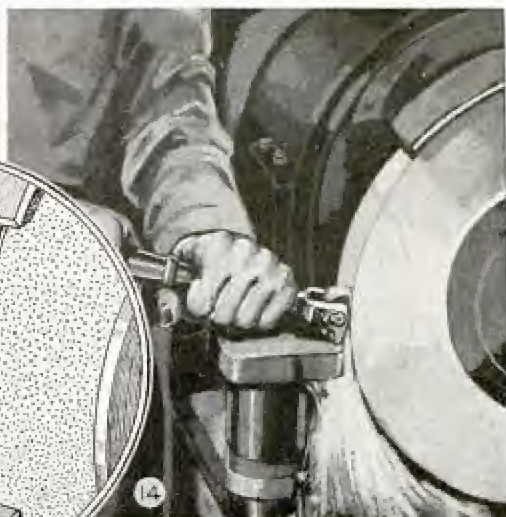
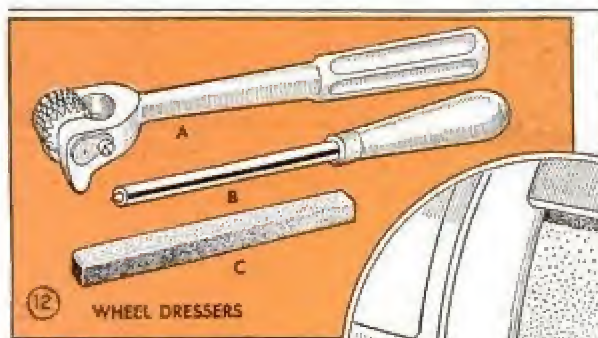
IN SEVERAL respects a grinding wheel is much like a circular-saw blade. Unless the circle of the saw teeth is concentric with the spindle and at right angles to it, the blade will not do satisfactory work. Essentially the same thing is true of a grinding wheel. Fig. 2 shows two common defects, due usually to wear and neglect, which can cause continued grinding-wheel trouble. You will notice that in neither case can you remove the wheel from the spindle, even after dressing, and replace it with assurance that it will run true. In detail A, the bushing is a loose fit on the spindle, either worn unduly or damaged by rough handling. Under this condition, the wheel will be out of true concentrically, that is, in relation to the spindle. Even though such a wheel is dressed carefully, the grip of the spindle flanges cannot be relied on to hold it true, especially under heavy stresses. In the second case, detail B, a section of the blotter on one side has been worn away. This throws the wheel out of true laterally, or sideways, and any undue tightening of the spindle nut in an effort to correct the fault may result in pressures which are dangerous in high-speed wheels. New blotters are fairly easy to apply by first scraping away all that remains of the worn blotter as in Fig. 4. Then cut new





disks from blotter paper to the same internal and external diameters as the originals and glue these to the wheel with a C-clamp and a block as in Fig. 5. Most any glue will serve. Although in an emergency heavy paper or thin cardboard will do, blotter paper is best. However, if available, it is better to use the ready-cut blotters usually obtainable from the manufacturer of the wheel.

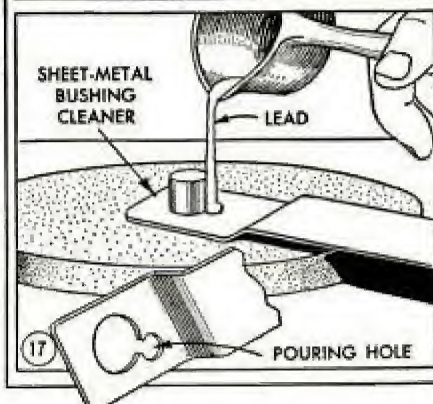
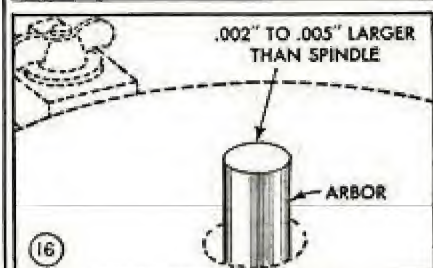
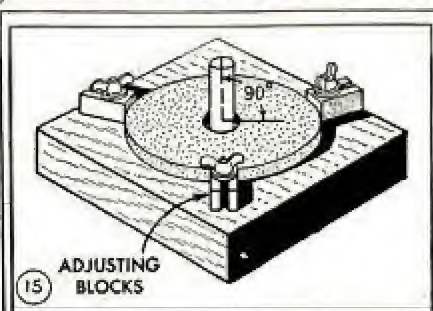
Renewing a bushing is a somewhat more extended operation. Where time permits it is perhaps advisable to return the wheel to the manufacturer for this job. But where it is necessary to keep the wheel in operation, one can, with care, do the work in his own shop. Sometimes, if the lead bushing is not worn too badly or distorted, it is possible to keep a wheel in service simply by wrapping a single thickness of suitable weight paper around the spindle as in Fig. 6. Where it is necessary to re-bush the wheel, proceed to remove the old bushing as at A and B in Fig. 11, first melting away the metal on opposite sides and then removing the balance with a sharp chisel. When doing this, care must be taken not to chip or crack the wheel. After this has been done, one can improvise a bushing chuck as in Fig. 15, by using a square piece of hardwood, true on both sides and somewhat larger each way than the diameter of the wheel. Bore a hole at the exact center of the block to take a bushing arbor, which may be a short length of steel shafting. Generally manufacturers recommend that the hole through the wheel bushing be from .002 to .005 in. larger than the diameter of the spindle as in Fig. 16. The latter must be measured and the arbor made accordingly. The arbor also must be a snug fit in the hole in the chuck, and must stand at right angles to the surface. Fit three adjustable clamps on the chuck as in Fig. 15. Place the wheel as shown and center it. Coat the arbor with a thin film of heavy grease, being sure that the grease is distributed evenly with no lumps or ridges at any point. Then make a bushing "cleaner" from a small piece of sheet metal to fit over the arbor as in Fig. 17. Adjacent to the arbor hole drill another small hole in the cleaner to serve as a pouring "sprue." Incidentally, it should be remembered that the proper grade of lead for bushings of this kind is of a pronounced grayish color when hot. Soft, thick lead, which is unsuitable for wheel bushings, is of a greenish, purple color when molten. Both lead and babbitt are used to bush grinding wheels, lead being the most common, although large cup wheels and

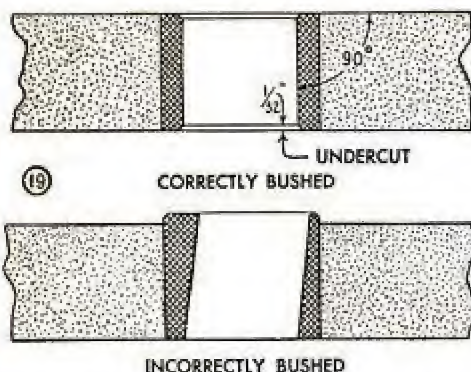


coarse wheels subject to heavy pressures often are bushed with babbitt. After the bushing has been poured, wait a few seconds for the lead to set, then swing the cleaner a quarter turn or so to shear off any excess. Carefully remove the wheel from the chuck and very gently drive out the arbor with a wood mallet, taking the greatest care to avoid distorting the bushing. Finally, to finish the job, the bushing is trimmed and undercut with a sharp chisel as in Fig. 18 so that no part of it projects beyond the sides of the wheel, Fig. 19. If necessary after this operation, disks of new blotting paper should be put on the wheel. When replacing a wheel on the spindle, it's very important to avoid drawing the spindle nut too tight. A light pressure on the wrench usually is sufficient as the nut tends to tighten when the wheel is in use.

A careful operator can do much to prevent undue wear on the wheel. Fig. 3 shows in somewhat exaggerated form some of the common shapes a wheel will wear into in a very short time unless some effort is made to distribute the wear of continuous grinding operations. Figs. 1, and 7 to 10 inclusive suggest several practical ways of doing this. Avoid varying pressures and unduly heavy pressure. When necessary to grind on the side of the wheel, Fig. 8, shift alternately from one side of the wheel to the other where practical. And when grinding a part or tool that is less in width or diameter than the thickness of the wheel, move the work across its face, as in Fig. 9, or on both edges as in Fig. 10, when grinding a V-groove and similar work.

Truing or dressing a wheel is simply another of those "careful" operations. There are, in general, three types of wheel dressers in use. Nearly everyone is familiar with the first of these, which is shown at A in Fig. 12. In use, this dresser generally is placed on the tool rest as in Fig. 13, with the two projections "hooked" over the edge of the rest. The latter is so adjusted that by raising the handle of the dresser as in Fig. 14, the loose rollers are brought into contact with the wheel face. In this way one has a fairly positive control over the pressure applied. The second type, which is widely used but quite expensive, is the diamond dresser shown at B. This consists of a small industrial diamond mounted in a handled holder. Many skilled operators use this dresser freehand, but for average work it is perhaps better to support it on the tool rest. When truing the face of the wheel the diamond should contact the surface slightly below the horizontal centerline of the





wheel. The third type of dresser, C, is simply a coarse-grained abrasive "stick" especially made for the purpose by manufacturers of abrasives. Both these latter dressers "cut" very fast and for this reason they should be used with care.

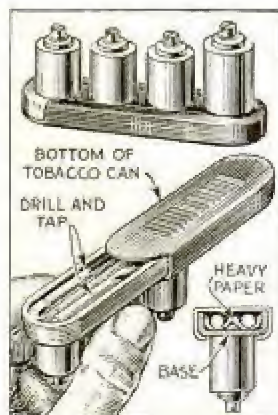
Customer Selects Sunglasses Unaided From Show Window

In order to increase sales of sunglasses without taking too much of his time waiting for his customers to make their selections, one merchant stuck some of the glasses to his show window as indicated. These were placed inside the window and were located at various heights so that it was easy for anyone to look through them. A photoflood lamp directed on artificial snow inside the window, produced a brilliant reflection, thus enabling the customer to pick glasses suitable to protect his eyes under any weather conditions.



Drill and Tap Stored in Base Of Toolmaker's Button Set

If you fit a sliding cover over the hollow base of your toolmaker's button set, a storage space will be provided for the tap and drill used in making holes for the button clamping screws. Having the correct size of drill and tap at hand with the set will save the time lost in looking for them, and will avoid the use of a drill and tap of the wrong size which may damage the clamping screws, or make it necessary to substitute

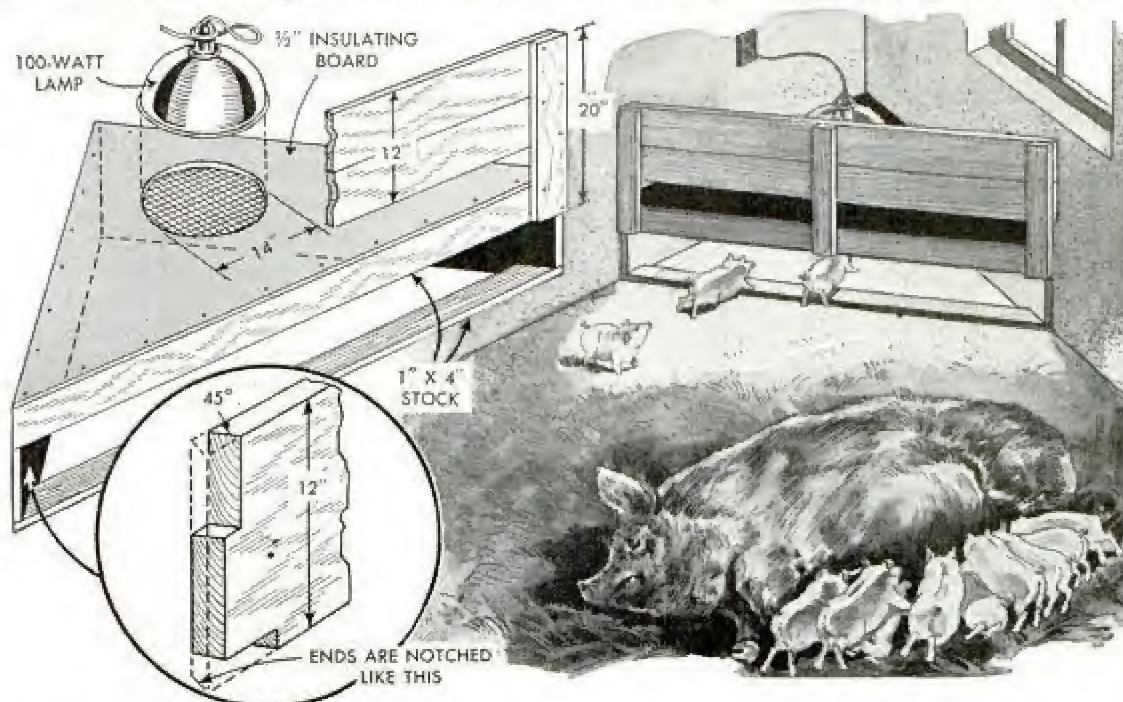


screws of different size. The bottom portion of a tobacco can will do for the cover. One end is removed from the portion used so that it can be slipped over the base, after which the sides are bent over the base.

Rack Made From Old Ring Gear

When a rack and pinion are needed for a mechanical movement and no rack is available, often one can be made by straightening an old ring gear of the type used on the flywheel of a car motor. Of course, a rack made in this way may not be accurate and may not stand up under hard use, but it will be satisfactory where it is used for short periods of time, or where the movement is slow. To straighten the gear, heat it to a red heat and then carefully straighten it in a vise or by hammering, taking care not to misshape the teeth. If there is a tendency for the teeth to close when the gear is straightened, bring the gear to a white heat and run the pinion over the teeth, pressing it down firmly. This action will tend to spread them to mesh more correctly with the pinion teeth. The pinion, of course, must have teeth of the same shape and spacing as those on the gear. As heating softens the gear, it should be hardened by heating to a cherry red and then plunging it into water.

Electric Pig Brooder Increases Your Profits



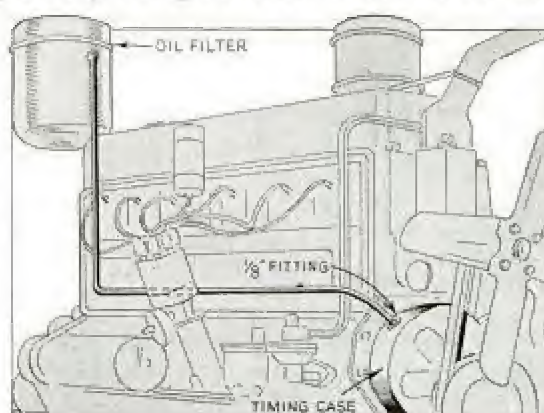
Loss of little pigs within a few days after farrowing can be reduced greatly by use of an electric brooder such as this one, which is recommended by the Rural Electrification Administration, U. S. Dept. of Agriculture. Besides protecting the pigs against chilling, the brooder also reduces the chances of the sow crushing them. Used in any weathertight building that otherwise is suitable, the brooder produces a steady, reliable heat. Naturally, heat requirements will vary with outside temperatures, but in general a 100 to 150-watt bulb will be sufficient. Experience has shown that it is best to place the sow in the brooder building a day or two before farrowing, and to operate the brooder for several hours before the pigs arrive. In

most cases, it is necessary to keep the pigs inside the brooder for several hours after arrival to be sure that they will be warm and dry. After this period, they will have to be put in by hand until they learn to go voluntarily. Ordinarily, the heat should be kept on for ten days, not including the time before the arrival of the pigs. The triangular brooder fits into one corner of the building and can be made from scrap boards. Insulating board is ideal for the top. The lamp and its reflector fit over a screened opening in the top, and are plugged into an electrical outlet in the building, using a heavily insulated cord of sufficient size to carry the current. For sake of safety, the brooder should be bolted to the building walls, or otherwise secured.

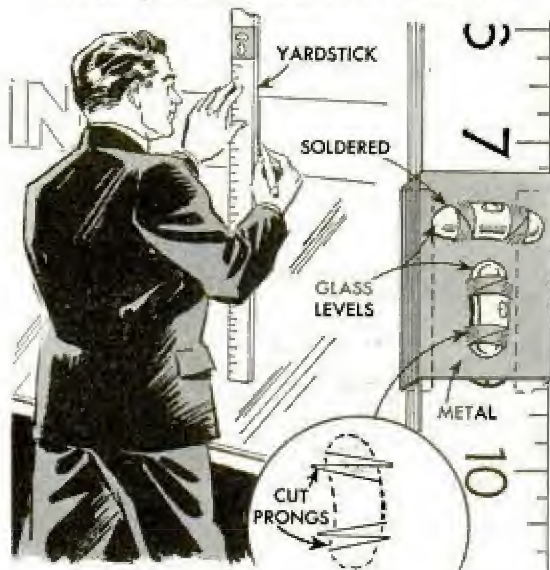
Life of Timing Chain Prolonged by Improved Lubrication

On some truck motors where the timing chains failed prematurely it was found that the only source of lubrication was by means of vapors rising from the crankcase. To provide better lubrication, a line was run from the clean-oil side of the oil filter to the top side of the timing chain case as indicated, a hole being drilled in the upper part of the case and then tapped to take a fitting to which the line was attached. In this way, filtered oil performed a lubricating function on its way back to the crankcase and thereby corrected a very aggravating problem.

—Jack A. Nelson, Des Moines, Ia.



Yardstick Level Aids Sign Painter In Layout Work on Window

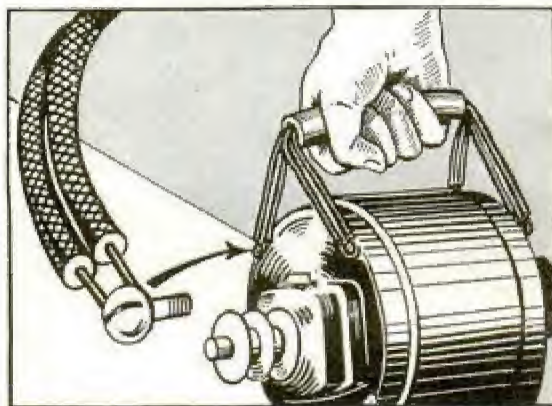


Used either in a vertical or horizontal position, this improvised level has been very helpful in my work as a sign painter, especially in getting layout work square on surfaces such as large windows and signs. Two glass levels, a piece of sheet metal and a yardstick or other straight-edge are required. After bending the metal to provide a sleeve with a snug, sliding fit on the yardstick, small prongs are cut in the metal and bent over the levels to hold them in place. It may be necessary to solder down the prong tips to hold the levels tightly. But before doing this, the accuracy of the entire assembly should be checked with a long carpenter's level.

—C. B. Wing, Jr., St. Ignace, Mich.

Handle to Carry Electric Motor Improvised From Heavy Wire

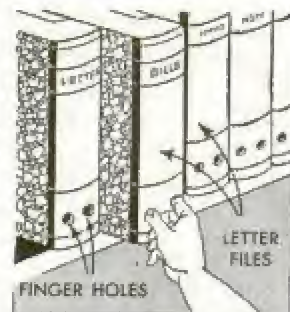
On farms and other places where one motor is used on several different jobs, the Rural Electrification News suggests using a carrying handle improvised from two



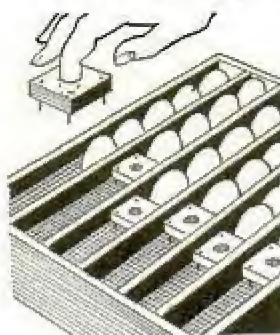
lengths of heavy insulated wire and a piece of pipe or hose as shown. Both lengths of wire are doubled, then run through the pipe or hose and the ends slipped under the bolts that attach the ends of the housing.

Finger Holes in Large Letter Files For Easy Removal From Shelf

Difficulty of removing large, book-shaped files from a shelf, especially a high one, can be overcome by cutting a couple of finger holes in the edge of the file as indicated. The holes enable you to get a good grip with the fingers for pulling a file from between others on the shelf.



Rolling Eggs in Incubator Trays Prevented by Wooden Blocks

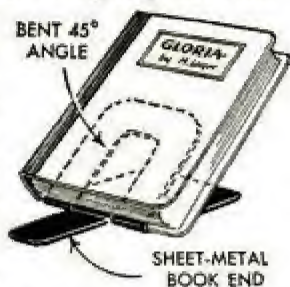


Although incubator trays may be filled with eggs so they can't roll about when first placed in the machine, the fertility test later will eliminate enough to leave many vacant spaces in the trays. To avoid having the eggs

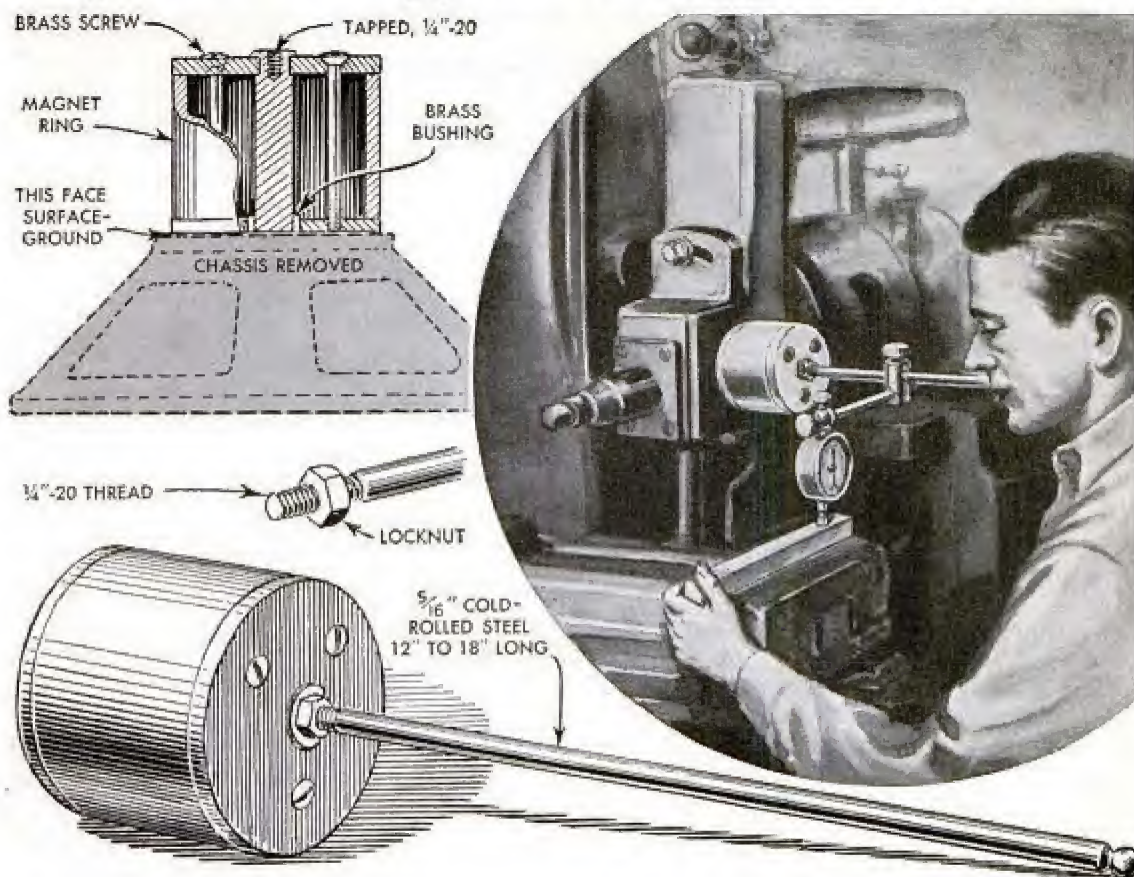
roll and break after this time, wads of paper often are used to keep the eggs close together. A better method is to use wooden follower blocks. These have finger holes drilled in the centers for easy lifting, and each one has a small nail at each corner to engage the meshes of the wire tray bottoms to keep the blocks in place.

Handy Way to Display Books

To hold books conveniently for his window display, one store owner uses metal book ends, the vertical parts of which are bent at an angle of about 45 degrees. In use, the bent portion of the metal is slipped between the back cover and pages, thus holding the book at a convenient angle for reading the title.



Magnetic Base Supports Dial-Type Test Indicator



With a magnetic base like this one attached to a dial indicator, any flat spot on a machine tool, either horizontal or vertical, provides a suitable surface to set it for convenience in testing work in a planer, lathe, grinder, etc. It is improvised at small cost from an old radio loudspeaker of the type having a permanent field magnet, which is removed by taking the assembly apart and breaking the spot welds holding

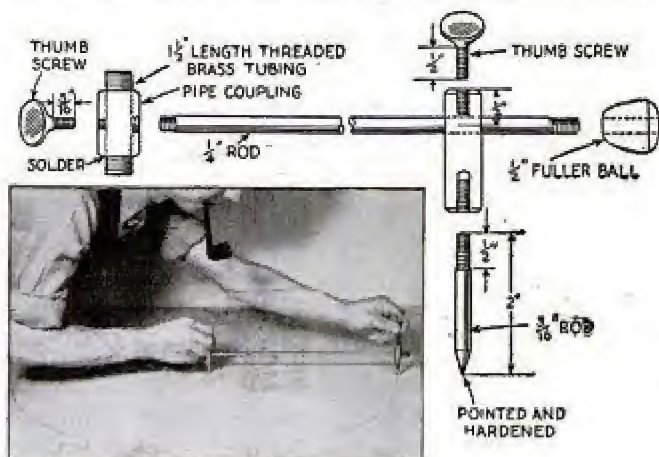
the lower plate to the chassis. Before re-assembling, this plate should be surface-ground so that good contact is had wherever it is placed. The space around the magnet core is filled with a brass bushing, after which a hole is tapped in the top to take a rod supporting the indicator. When not in use, the device should be set on an iron surface to preserve its magnetism.

—Peter W. Mueller, St. Louis, Mo.

Beam Compass Doubles as Trammel to Ink or Scribe Metal

Circles of practically any size can be drawn in pencil, inked or scribed on metal with this combination beam compass and trammel by simply interchanging the pencil with a draftsman's ruling pen or a center punch. Its capacity is limited only by the length of the rod, which is threaded at the end for coupling extensions. A fuller ball provides a neat knob to protect the threads. If the handle of the ruling pen is too small to fit the pencil holder, it can be wrapped with a few turns of adhesive tape.

—Arthur Trauffer, Davenport, Ia.



Hinged Ledge on Cashier's Desk Serves as Coin Stop



Sloping-top desks that often are used by cashiers in banks and offices, can be improved for this purpose by hinging a small ledge to the lower edge. Then, when counting and packaging coins, the ledge can be turned over the edge of the desk to prevent coins from rolling onto the floor. When not in use, the ledge hangs down out of the way.

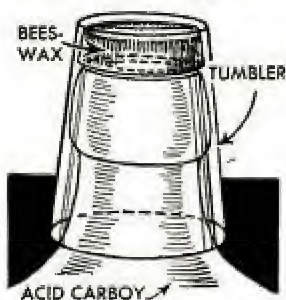
Show Cards Dried in Pocket Comb



the cards spaced so they do not touch, and make them easy to remove.

Tumbler With Beeswax in Bottom Substitutes for Carboy Stopper

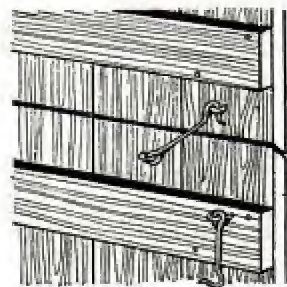
After misplacing the stopper for an acid carboy, one workman made a good substitute by putting a little melted beeswax in the bottom of a glass tumbler, which then was inverted



over the mouth of the carboy. The soft beeswax made a good seal between the tumbler and carboy. Also, it was found that the substitute stopper saved time when used on other acid bottles that had to be opened frequently during working hours as only one hand was required to remove the tumbler, whereas both were needed to remove the regular stopper.

Extra Hook Holds Double Doors To Operate as One Unit

If it sometimes is desirable to have double barn doors open or close as a unit, this can be accomplished by attaching an extra hook and staple to the inside of the doors as shown. The hook should be attached to the lower door so that it will drop down out of the way when not in use.



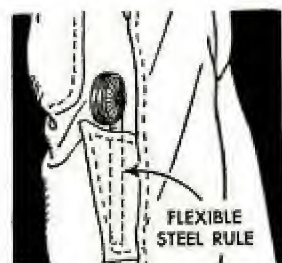
Spring-Hinged Cover of Oil Cup Opened by Notched Oilcan Spout



Instead of using both hands to open and fill oil cups of the type that have spring-hinged covers, cut away part of the oilcan spout at the end as indicated. This will enable you to raise the cover by pushing the spout end under it, in which position oil will run from the spout into the cup without changing the position of the oilcan.

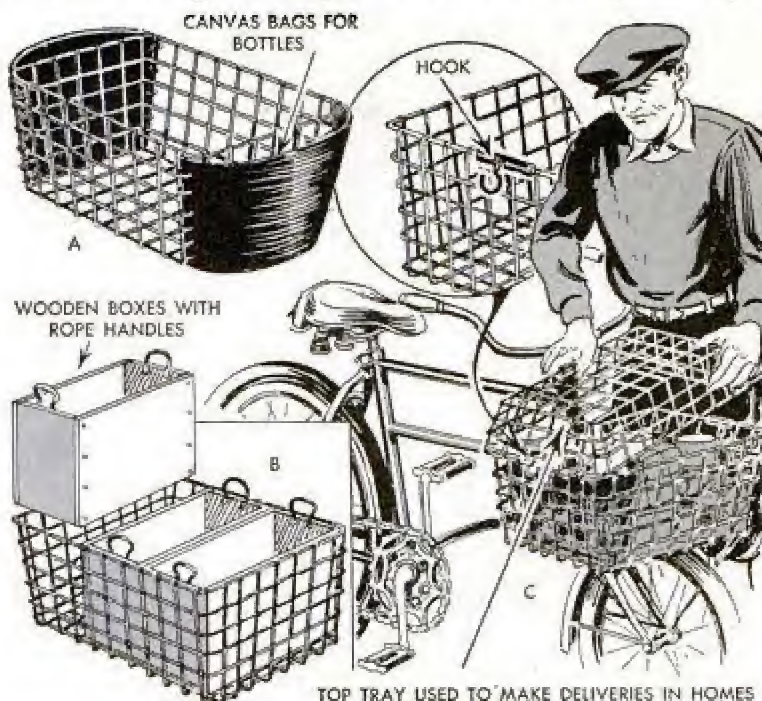
Flexible Steel Rule Partly Opened Is Easy to Remove From Pocket

In order to have his flexible steel rule instantly at hand and easy to remove from his pocket, one carpenter pulls out the end for a distance of several inches from the case. In this position, the end of the rule is inserted into the rule pocket of his overalls where it is carried safely with the case projecting for easy removal.



Three Kinks That Help Bicycle Delivery Boys

Boys who make store deliveries on bicycles fitted with large baskets will find that these kinks enable them to do their work more easily. The problem of carrying bottled goods or merchandise that is crushed easily is solved by fitting canvas bags or pockets to the ends of the basket as shown in detail A. Where several small deliveries are made at one trip, three or four light wood boxes made to fit inside the basket as shown in detail B will hold the individual orders. When several orders are placed in the basket, a removable basket as in C provides a tray for carrying the orders into homes.



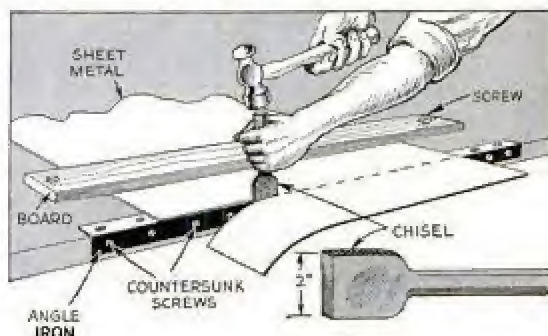
Buttresses Protect Frames of Loading Doors at Warehouse



Damage to the sill and frames of a loading door, which was caused by trucks backing into it, was avoided at the warehouse of a storage company by the use of concrete buttresses. These were made on each side of the doorway and projected a foot or so above the sill as indicated, to assure contact with truck bodies of various heights. Heavy sheet metal was used to sheath the frame on its inner surfaces and above the buttresses. This arrangement not only improved the appearance of the doorway, but also reduced maintenance cost to a minimum. If desired, a concrete step can be provided between the buttresses for entrance to the door. A piece of heavy plate metal bridges the space between the door sill and the truck.

Angle Iron on Bench Edge Is Handy for Shearing Heavy Sheet Metal

If you have to cut a large piece of sheet metal that is too heavy for regular hand shears, try the following method: Just screw a length of angle iron, such as an old bed rail, to one edge of your bench. Then use the iron as a shearing edge in combination with a wide shearing chisel as shown. Place the work on the bench with the shearing guide line at the edge of the angle iron and clamp the work in place with a board or wood strip screwed to the bench top.



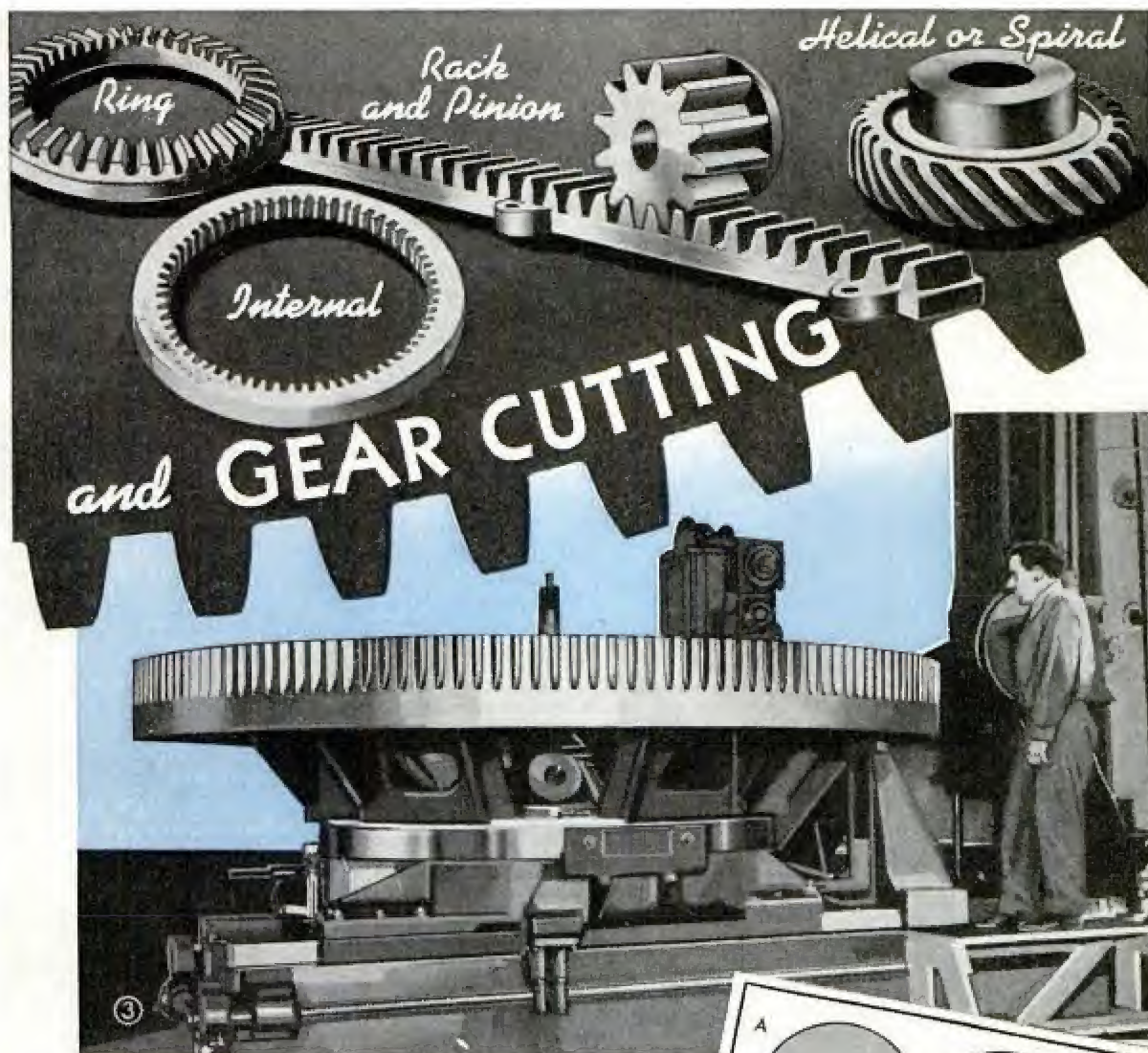


By H. J. Chamberland

GEARS play a highly important role in many products where it is necessary to transmit power from one part to another within a limited space, especially in the case of machine tools. With this in view, any machine-shop worker should know something about gears and the nomenclature involved, inasmuch as he may be put to working in connection with their production, and certainly will have occasion at some time or other to make use of them. However, in this article, which covers the subject of gears only in an elementary way, most information relating to gear design will be omitted.

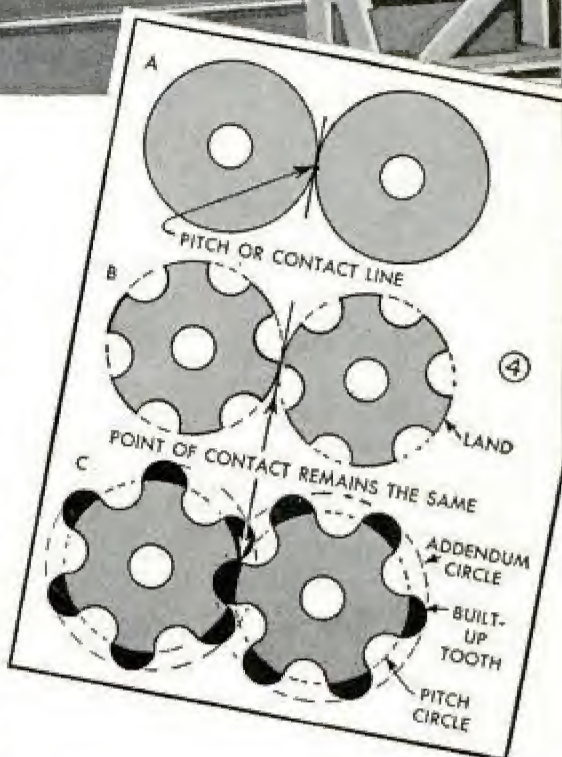
Common types of gears: Depending upon requirements, gears are made in various types and sizes. Their success or failure,

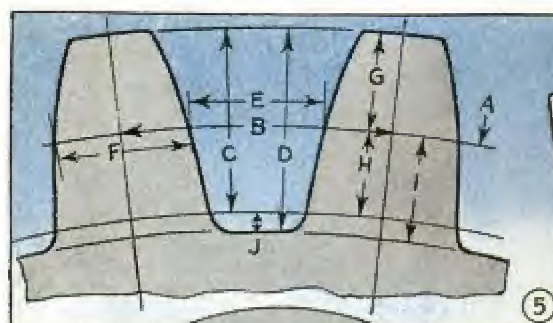
and also their length of service, depend to a great extent on the material from which they are made and the heat treatment given, while their efficiency of operation is governed largely by the accuracy of the tooth form. Spur gears, shown in the heading and also in Figs. 1, 3 and 12, are the most common in use. Their teeth are cut straight across, parallel to the axis of the blank disk from which they are machined. The diameter of the bore of a gear must be checked with considerable accuracy, for which purpose vernier calipers are used as shown in Fig. 1. Other types of gears are known as helical (or spiral), herringbone, bevel and miter (a 45° bevel gear) and worm gears, which are shown in the heading. The smaller gear of a pair is called a pinion; a gear at the source of power is



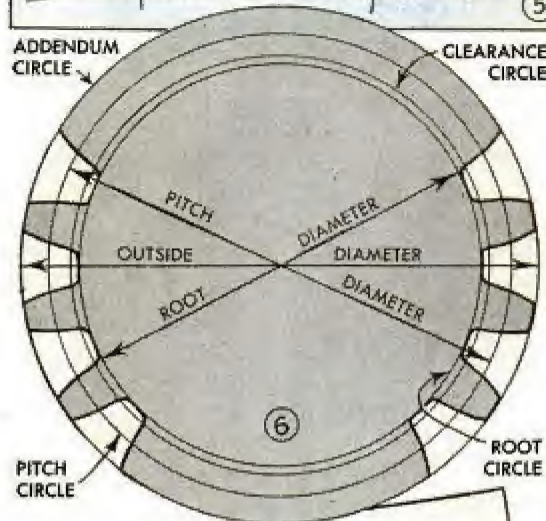
referred to as a driving gear or a driver, while one to which power is transmitted from the driver is called a driven or follower gear. A "train" of gears consists of several arranged in any combination, as for instance a train of gears found in a screw-cutting lathe as in Fig. 2.

Gears versus frictional wheels: If two disks or wheels are held so that their circumferences contact each other as shown in detail A of Fig. 4, a rotation of one will cause the other to rotate, provided the friction between the two is sufficient. Obviously, some power can be transmitted in this way but where it is necessary to transmit considerable power, friction alone between the surfaces is undependable, as there may be slippage. This inefficiency is basically the reason for having gears, which are simply disks or wheels to which teeth are added so that intermeshing gears can rotate without slippage, power being transmitted by the teeth. You will note from





- A—Pitch line or pitch circle
 B—Circular pitch or distance between centers of two adjacent teeth, measured along pitch circle
 C—Working depth of gears
 D—Full depth of teeth
 E—Width of spacing between adjacent teeth, measured along pitch line
 F—Thickness of tooth at pitch line
 G—Depth of addendum or face
 H—Working depth below pitch line or flank
 I—Space below pitch line or dedendum
 J—Clearance



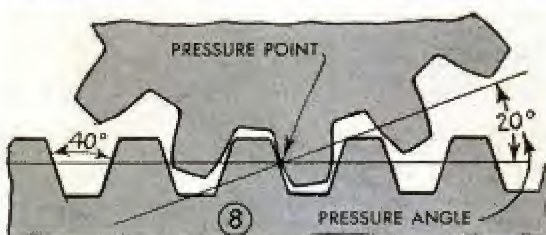
Symbol	Definition
P	—Diametral pitch or number of teeth per inch of pitch diameter
P'	—Circular pitch
N	—Number of teeth
D	—Outside diameter
D'	—Pitch diameter
f	—Clearance at bottom of tooth
D''	—Working depth of tooth
D'' + f	—Full depth of tooth
D'''	—Bottom diameter
D''' + f	—Addendum
s + f	—Dedendum
t	—Thickness of tooth on pitch line

details B and C of Fig. 4 just how gears having the same diameter as the disks in detail A, are evolved. A number of equal-size, semicircular portions are cut out equidistantly on the circumference of the disks, after which the cut-out pieces are joined to the disks on the intervening spaces or "lands" along the circumference, to form teeth. Note that in the transformation from disks to gears, the center-to-center distance has remained the same, but that the outside diameter of the gears is greater than the diameter of the disks.

Pitch circle and pitch diameter: When referring to the size of gears, as in machine-design drawings, it is not the outside diameter which is meant, nor the inside or "root" diameter along the bottom of the teeth, but the diameter at the approximate center of the teeth—in other words, the

diameter of the disks in detail A of Fig. 4. This is known specifically as the "pitch diameter," while the circumference of the disk becomes the "pitch circle" of the gear. Fig. 6 shows the three diameters of a gear and the relating circles, while Fig. 7 gives gear symbols.

Diametral pitch: With the meaning of pitch diameter and pitch circle established, it is easy to understand what is meant by "diametral pitch," a term designating the tooth size of a gear. It is not an actual dimension but it is the ratio between the number of teeth on the gear and its pitch diameter in inches. Thus, a 4 diametral pitch gear has four times as many teeth as it has inches of pitch diameter. If the latter were 12 in., there would be 48 teeth on the gear. In other words diametral pitch is the number of teeth per inch of pitch diameter. Spacing and size of the teeth can be determined readily from this information.



CUTTER	ACTUAL SIZE
#5	#8
FROM SET OF 8-DIAMETRAL PITCH	
GEAR	
No. of cutter	Amount of teeth cut
1	From 135 teeth
2	" 55 teeth to 134 teeth
3	" 35 " " 54 "
4	" 26 " " 34 "
5	" 21 " " 25 "
6	" 17 " " 20 "
7	" 14 " " 16 "
8	" 12 " " 13 "

(10)—HOW GEARS ARE SIZED

TO FIND DIAMETRAL PITCH (P)
when number of teeth and outside diameter are known. Add 2 to number of teeth and divide by outside diameter. Example: 40 teeth and $10\frac{1}{2}$ in. diameter: 40 plus 2 divided by $10\frac{1}{2}$ in. equals 4. Ans. 4 diametral pitch.

TO FIND CIRCULAR PITCH (P')
when diametral pitch is known. Divide 3.1416 by diametral pitch. Example: 4 diametral pitch: 3.1416 divided by 4 equals .7854 in. Ans. .7854 cir. pitch.

TO FIND NUMBER OF TEETH (N)
when outside diameter and diametral pitch are known. Multiply outside diameter by diametral pitch and subtract 2. Example: $10\frac{1}{2}$ diameter and 4 diametral pitch: $10\frac{1}{2}$ in. multiplied by 4 and minus 2 equals 40. Ans. 40 teeth.

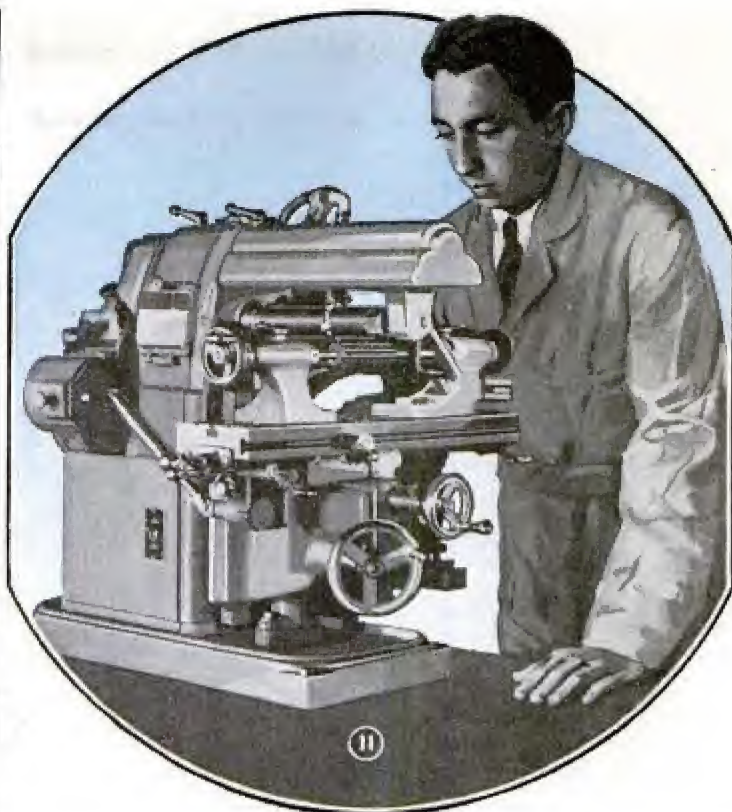
TO FIND OUTSIDE DIAMETER (D)
when number of teeth and diametral pitch are known. Add 2 to number of teeth and divide by diametral pitch. Example: 40 teeth and 4 diametral pitch: 40 plus 2 divided by 4 equals $10\frac{1}{2}$. Ans. $10\frac{1}{2}$ in. outside dia.

TO FIND PITCH DIAMETER (D')
when number of teeth and diametral pitch are known. Divide number of teeth by diametral pitch. Example: 40 teeth and 4 diametral pitch: 40 divided by 4 equals 10. Ans. 10 in. pitch dia.

TO FIND CLEARANCE (f)
when diametral pitch is known. Divide 1.57 by diametral pitch. Example: 4 diametral pitch: 1.57 divided by 4 equals .392 in. Ans. .392 clearance.

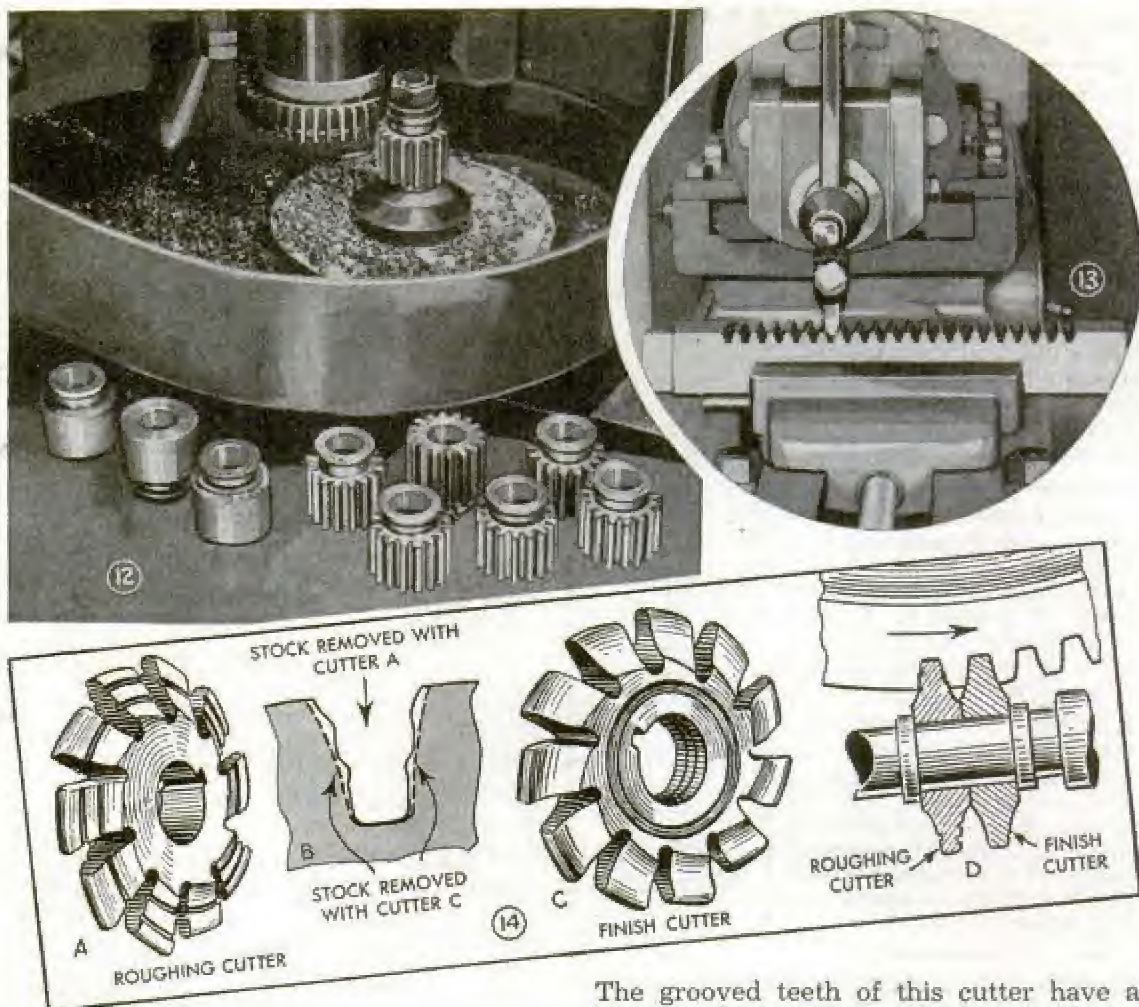
TO FIND FULL DEPTH OF TOOTH
(working depth plus clearance) when diametral pitch is known. Divide 2.157 by diametral pitch. Example: 6 diametral pitch: 2.157 divided by 6 equals .3595 in. Ans. .3595 full depth of tooth.

TO FIND THICKNESS OF TOOTH AT PITCH LINE (t)
when circular pitch is known. Divide circular pitch by 2. Example: 1.047 circular pitch: 1.047 divided by 2 equals .523 in. Ans. .523 thickness of tooth.



Circular pitch: On large gears, the tooth size may be designated by the term "circular pitch." This is the distance between the centers of two adjacent teeth measured on the pitch circle as indicated by B in Fig. 5. To translate this into equivalent diametral pitch, you divide 3.1416 by the circular pitch. Or, if you desire to know the circular pitch when only the diametral pitch is given, you simply divide 3.1416 by the diametral pitch. For examples, refer to Fig. 10. The number of teeth on the circumference of a gear is largely determined by the amount of power that must be transmitted from one gear to another, and the strength of the gear teeth themselves. The angle at which the gear teeth press against teeth of a mating gear or rack is called the pressure angle as indicated in Fig. 8. In gear-cutting practice, pressure angles of $14\frac{1}{2}$ and 20 degrees are commonly used. For calculating the size of gears, there are eight important formulas and examples listed in Fig. 10. These can be applied without much knowledge of mathematics. However, to go deeper into gearing such as computing helical, bevel, worm gears, as well as the more complicated types, one must expect to deal in geometrical terms.

Gear-cutting sets: If the teeth of all gears had to be cut with separate cutters, a considerable and prohibitive investment for cutters would be required. Hence, for the sake of economy and simplification, a system is in practice whereby sets of cutters, each comprising eight cutters for each pitch, will handle all problems. Fig. 9 shows the comparative increase in radius between a No. 5 and a No. 8 cutter of the 8-diametral pitch set. The tooth form of a cutter of a set remains fixed and this cutter will produce the precisely correct tooth form only on a gear of certain diameter and number of teeth.



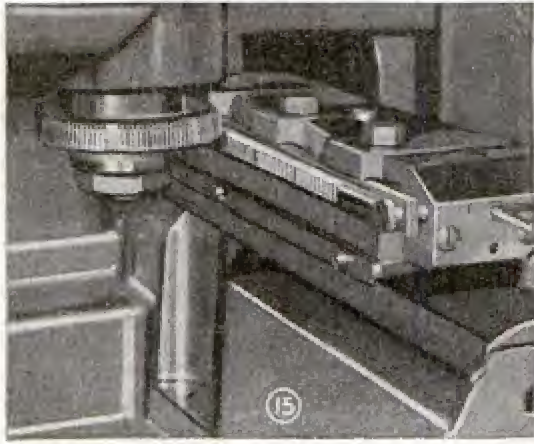
Each cutter of a set is designed to be perfectly correct for the lowest number of teeth in the range it covers. For example, a No. 2 cutter, which cuts from 55 to 134 teeth, has the correct curve for 55 teeth, so the more teeth this cutter has to cut the more rounded will be the teeth of the gear because the length of the bearing on each tooth decreases as the number of teeth increases. Naturally, gears cut according to this procedure cannot be expected to operate as smoothly as they would when having their individual or theoretical curve.

Gear-cutting procedures: Gear teeth are cut by milling, hobbing and shaping. Hobbing, a specialized form of milling and gear shaping, is done in a machine having no connection to a conventional shaper. The operation is similar to a milling operation and small gear cutters are often cut in gangs as shown in Fig. 11 by completing each flute with a single cut. Larger gears usually are made by cutting them singly, using a roughing or stocking cutter first, detail A of Fig. 14, and then a regular finish cutter as shown in detail C. The effect of the roughing cutter is shown in detail B.

The grooved teeth of this cutter have a chip-breaking action, which permits faster and cleaner cutting with very little stock remaining for finishing. When cutting gears of large size, both cutters may be operated in a gang as shown in detail D, in which case the cutters do their work simultaneously and at a marked saving in time.

The hobbing method of gear cutting shown in Fig. 16 is continuous rather than intermittent as with a plain cutter, which requires indexing for each tooth. The cutting tool is a hob, which resembles a worm gear except that it has cutting teeth and produces equally spaced teeth on a cylindrical surface. The hob and the gear blank revolve at correct relative speeds by means of gearing, the hob advancing uniformly to cut teeth with the correct pitch.

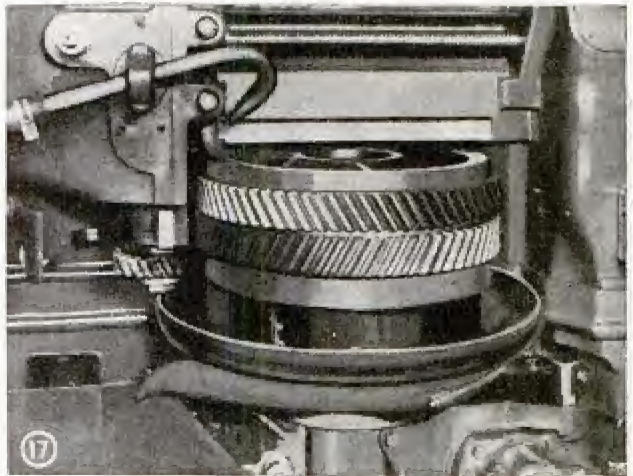
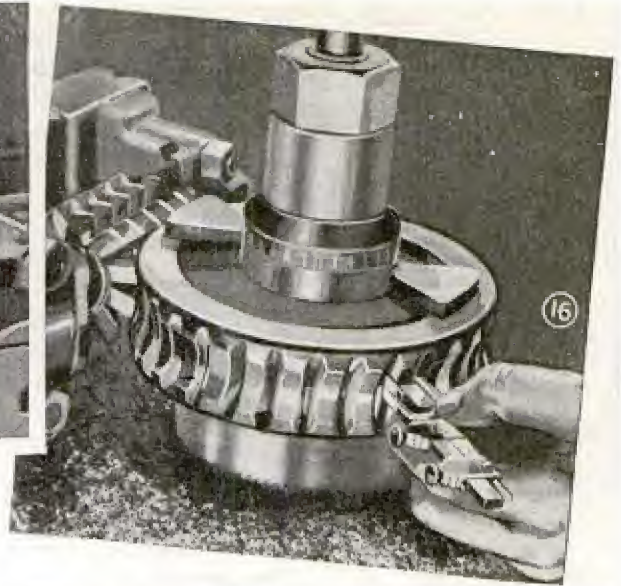
The most productive method of gear cutting is by shaping, as in Fig. 12. A gear shaper uses a cutting tool which is essentially a hardened gear with its teeth properly relieved. When starting to cut a gear, the cutter is first fed down against the edge of the blank to proper depth, after which it reciprocates at a speed of about 800 strokes per minute while both gear blank and cutter revolve and the teeth on the



blank are cut in one rotation of the blank. However, often two cuts are taken for extremely precise tooth forms. This method is efficient, as one cutter of any pitch will cut any number of teeth of that pitch, whereas a formed cutter will cut but a limited number of teeth.

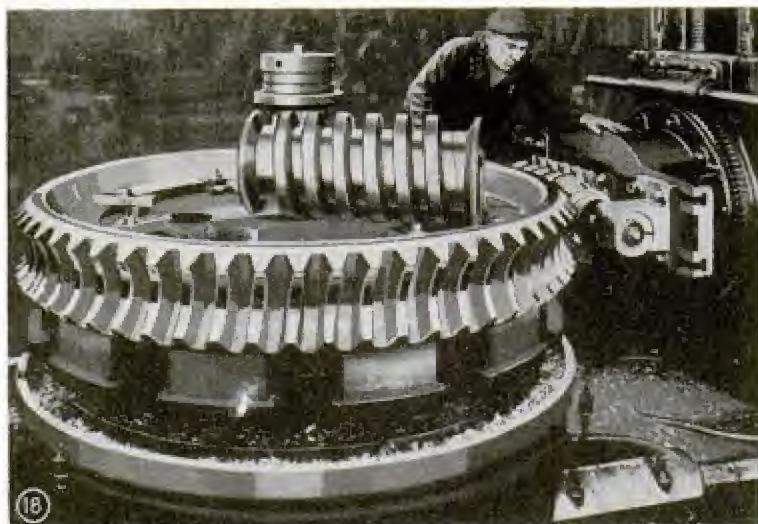
As shown in Fig. 13, teeth in gear racks are often produced in regular shapers and even planers with a tool bit formed accordingly. This procedure is rather slow, as each tooth must be cut separately, but the procedure is practical to duplicate a broken or worn part. In quantities, racks are cut as shown in Fig. 15. The herringbone gear being cut by the shaping method in Fig. 17 actually comprises two helical gears with teeth angles in opposite directions. Such a gear is often made in two parts with a milling cutter or end mill, but can be cut also by shaping. Helical (or spiral) and herringbone gears are used extensively to transmit heavy loads with extreme quietness, as for example in autos. Except for somewhat more involved computation of tooth form, these gears can be machined as easily as spur gears.

A bevel gear has its teeth cut on an angular face to transmit power to shafts set at an angle to each other. When both shafts are at an angle of 45 degrees, the gears are known as miter gears. In this the teeth are usually straight but they also can be cut spirally for increased strength and driving power plus smooth operation. The cutting of bevel gears involves a different problem than other types due to the difference in diameter at both ends of the gear blank. The diametral pitch of bevel gears is that of the larger end of the teeth but the pitch gradually changes toward the smaller end. Due to this change in pitch, bevel gears can be cut accurately only by shaping if quantity is involved. However, for quality, the teeth can be milled to their greatest



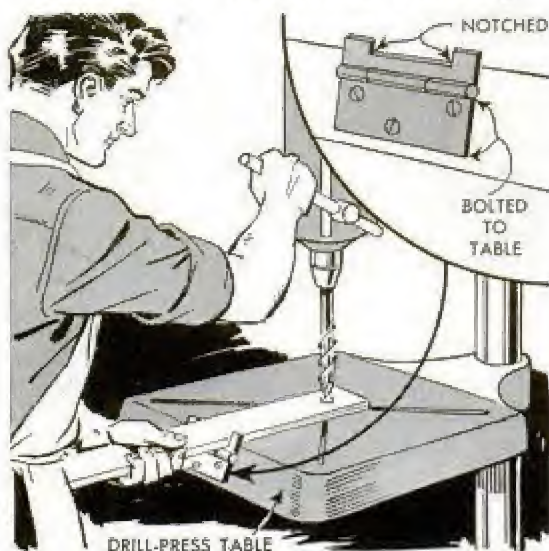
extent and the small ends finished by filing them to produce their shape as nearly correct as possible. This latter course requires extreme care since the maximum bearing point of those gears should be at the small end.

Worm gearing is also somewhat different than other forms of gearing. As shown in Fig. 16, it consists of a screw and worm wheel, the latter being somewhat similar to a helical gear with its face concaved to match the form of the screw thread. When a hobbing machine is not available, worm wheels may be cut by milling. In this case the procedure is to set the milling machine table at the proper angle, after which the operator proceeds to rough the teeth with a cutter of predetermined diameter by repeatedly indexing and feeding the wheel against the cutter vertically. Then the correct tooth form is produced as in Fig. 18, with a hob fitted to an arbor and the assembly revolving freely between centers with the teeth of the hob meshing with the rough teeth of the wheel. In this case how-



ever a machine of the vertical boring mill type was used. Fig. 16 is a regular hobbing machine setup and the depth of tooth is shown being checked with a gear-tooth vernier. The worm wheel also, shown in Fig. 18 presents no form cutting difficulties. The screw form can be produced in this or in another type of milling machine with a hob or plain-formed cutter, in a hobbing machine, in a specially tooled gear shaper or in a lathe.

Notched Hinge on Drill Press Prevents Work From Turning



A convenient stop to help prevent work from turning on a drill press is provided by welding a small butt hinge to the front side of the table. The upper half of the hinge is notched and is left free to swing up or down out of the way as necessary.

Addressograph Plates Identified By Different Colors of Paint

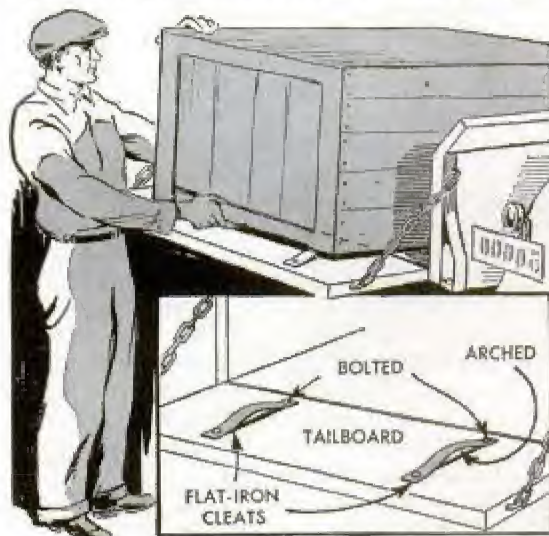
Business firms using addressograph metal name plates for addressing mail will find the following method of identifying them a space and money saver, especially when there are many separate mailing lists of customers for different purposes. With this method, it is unnecessary to have two or more plates for one customer whose name may appear on more than one list, because the plates for all lists are kept in one large

alphabetical file. Then, whenever certain lists are desired, the plates marked with the color identifying this list are withdrawn and used. To apply the identifying color, simply take out all the plates in one list, line them up and paint a colored stripe about $\frac{1}{4}$ in. wide across the top edges so that a little color is left on the edge of each plate. When the plates are replaced in the large file this list can be found easily by looking for the band of identifying color. Each list is marked with a different color.

—David O. Munroe, Chicago.

Iron Cleats on Truck Tailboard Raise Crates for Easy Sliding

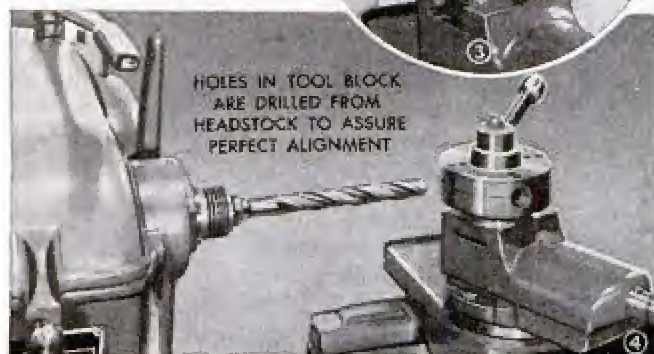
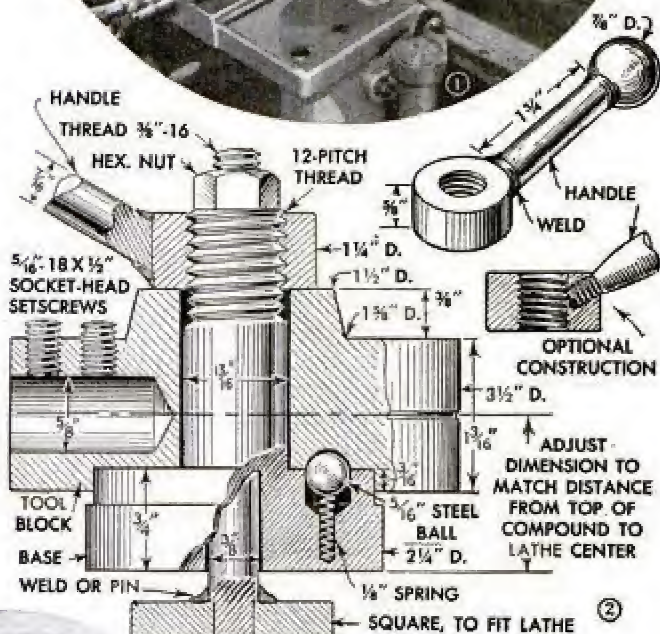
The difficulty of inserting the hands, or the beak of a hand-truck, under a heavy crate in a truck for unloading may be overcome by bolting curved strips of flat iron to the inside of the board as shown. The crate may be slid onto these and at the same time be elevated to the desired height.



4-Place TURRET

Fits Lathe Carriage

WHILE revolving turret heads usually are considered production tools, the particular turret pictured in Fig. 1 will be found handy for general lathe work. When provided with stub boring bars, it will handle almost all jobs of internal boring or threading. If fitted with a three-jaw chuck or Morse-taper adapter in one of the tool holes, the turret provides a means of drilling or reaming from the lathe carriage where a power feed seems desirable. Start the construction by making the base. As shown in the drawing, Fig. 2, the base and central stem are turned in one piece. Next, the indexing element, which consists of a $\frac{3}{16}$ -in. steel ball and a $\frac{1}{8}$ by $\frac{1}{2}$ -in. spring, is set into the base as indicated, to engage recesses in the tool block as shown in Fig. 3. Then the tool block is turned and is bored in the center for a snug rotating fit around the stem of the base. Put a sharp-pointed pin in the index hole and rotate the tool block to scribe a line on the bottom. On this line, index and drill the four recesses to take the index ball. Use a standard $\frac{3}{8}$ -in. bolt for locking the assembly in the lathe compound, welding or pinning the bolt to a square piece of metal, to fit the T-slot in the compound. Finish all the rest of the construction except drilling the holes



in the tool block. These holes are drilled with the turret head fitted to the lathe compound. The base of the turret should be rotated so that the first hole drilled comes between any two of the index recesses. The indexing element then sets the position of the three remaining holes, the drill working from the headstock as shown in Fig. 4. Take great care in drilling the tool holes. Tool holes of $\frac{5}{8}$ in. in diameter are recommended, as this size takes the smaller sizes of standard turret accessory tools, which you may want to purchase or make. Tools with smaller shanks or with Morse-taper shanks can be held in bushings or taper-shank adapters, which you can make up as occasion requires.

Handle Between Legs of Sawhorse Makes It Easy to Carry



Anyone who has occasion to carry a sawhorse to and from work that is located at some distance from the shop, or who has to carry a sawhorse about on jobs that cover considerable area, will find that a handle like the one shown makes the job easier. The handle consists of a length of dowel or small pipe fastened into holes drilled in the leg braces.

Extension for a Paper Trimmer Doubles Its Capacity

One workman who often had to use a paper trimmer on work that was considerably longer than the trimmer board, made an extension for the board like the one shown. This arrangement permitted the

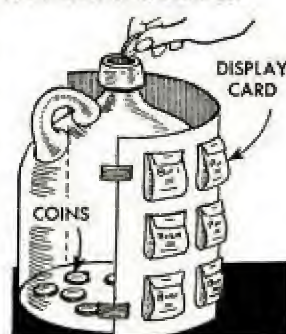


measuring and trimming of the long work without excessive loss of time. If the trimmer is supported on short legs or a standard, they will have to be removed or similar supports provided for the extension. When not in use, the extension, which is hinged to the end of the trimmer board, can be folded under it out of the way.

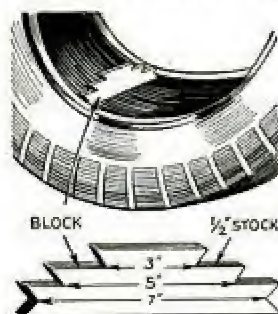
Glass Jug Holds Display Card For Self-Service on Counter

One merchant was able to save time for his clerks by providing self-service for items attached to display cards. The cards of merchandise were taped around glass jugs as indicated and set on the counter.

A few coins dropped inside the jugs suggested to the customer that he could serve himself.



Stepped Spreader Holds Tire Open While Installing Blowout Patch

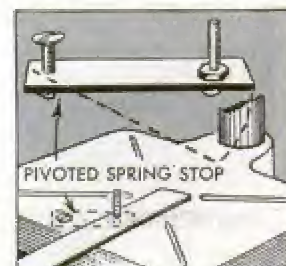


Mechanics who have considerable tire repairing to do will find this simple spreader handy for keeping a tire spread while inspecting it or while installing a blowout patch. The spreader is stepped so that it

can be used on a wide range of tire widths, and is made from a 1/2-in. wood block.

Spring Stop in Drill Press Table Prevents Work From Turning

This simple spring stop will help keep work from turning on a drill-press table, and can be pushed down and to one side out of the way when not needed. The stop consists of a short length of clock spring carrying a bolt at one end, which projects through a hole in the drill table. The other end of the spring is bolted to the underside of the table.



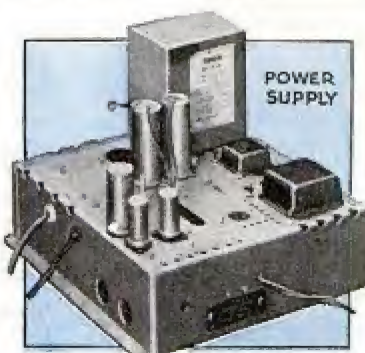


Television Receiver Units

ALTHOUGH about twice the size of ordinary console receiver units, the modern television chassis and power supply is not as large or as complicated as the average radio student and experimenter thought they would be, considering that they are designed for both sight and sound reception.

The RCA model TRK-120 television chassis shown in the photo provides complete sound and picture (Pix.) channels for 5 bands, as follows: 44-50 MC, 50-56 MC, 66-72 MC, 78-84 MC, and 84-90 megacycles. The overall "video" or picture band width is 4 megacycles. Scanning is interlaced, producing 30 frames, or complete pictures of 441 lines each, 30 times a second.

Delivering 7,300 volts d.c. for the cathode-ray receiving tube anode, and other necessary operating voltages, the separate power supply unit is connected to the television chassis by means of heavy



well insulated cables. This power unit measures 15 by 13¼ by 10 in. overall; the television chassis base is 16 in. wide, 17 in. long and 4½ in. high. No tubes are shown in these units which have been available to radio training schools and experimental laboratories.

The television chassis layout, showing all tube types and their location, appears in Fig. 1, with the exception of the type 1803-P4 twelve-inch television tube which is mounted separately; the power supply unit employs one 5U4G and one 2V3G tube. Although there seems to be a multiplicity of controls, many of them only require an initial setting, after which all tuning and adjusting for both sight and sound is done with the comparatively few controls located at the front. The television tube may be mounted for direct viewing or the image may be reflected by a mirror.

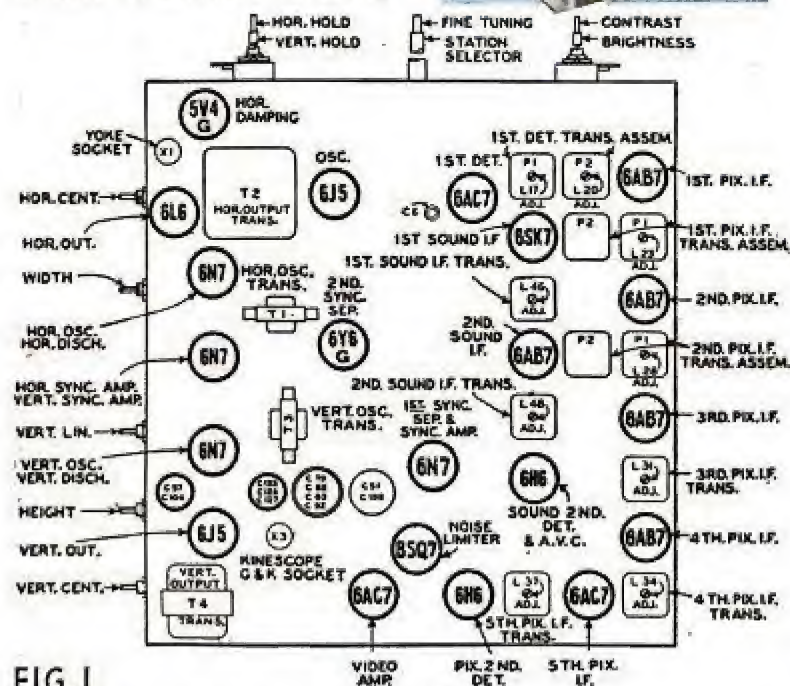


FIG. 1

JANUARY, 1944

MAKE THE PARTS FOR

By Lawrence B. Robbins

MOST radio students and experimenters have a variety of odds and ends of useful parts for making experimental hookups, and often fill in the gaps with noncritical materials that are available from radio mail order supply houses. The newcomer in radio who does not have a stock of parts but does possess a good pair of headphones, can just about start from scratch with either of the two simple crystal sets to be described.

Although some of the material for these receivers was salvaged from an old discarded broadcast receiver, practical duplicates of the coils, condensers and crystals can be made from scrap materials as detailed in Figs. 2, 3, 4, 6 and 8. The schematic circuit diagram for set No. 1, shown in photo A, appears in Fig. 1. This set employs variometer tuning, thus doing away with the usual variable condenser. The variometer is merely a continuous winding distributed on two cardboard coil forms, the smaller of which will turn on an axis inside the larger. This unit may be wound with any small size enamel-, cotton- or silk-covered wire as detailed in Fig. 2 and assembled as shown in Fig. 5. The wire can be salvaged from an old filter choke or audio transformer, but preferably of slightly larger size if available; anything from about No. 24 to 32 may be used. However, the leads from the stator to the rotor sections of

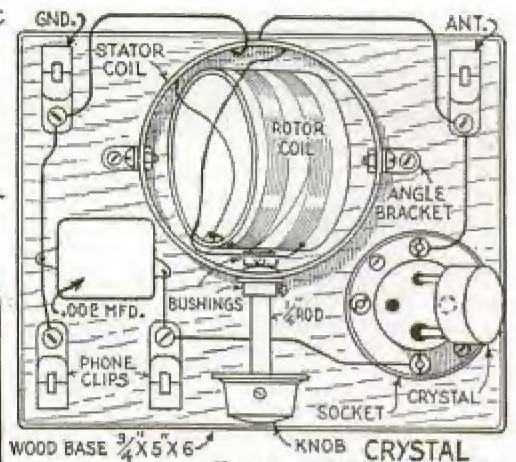
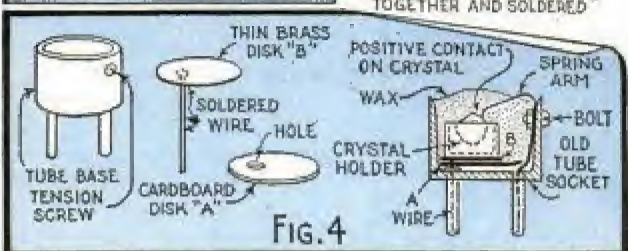
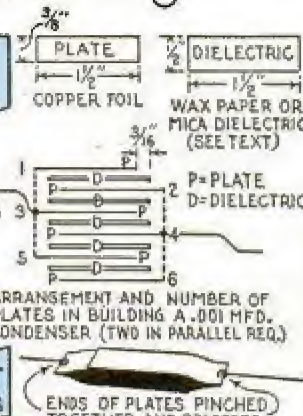
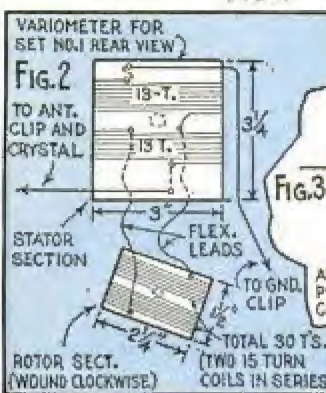
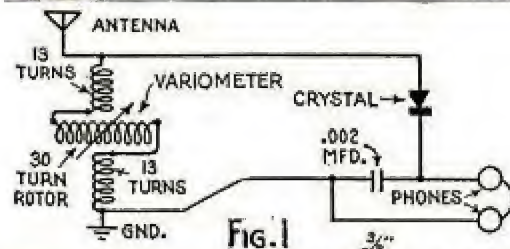
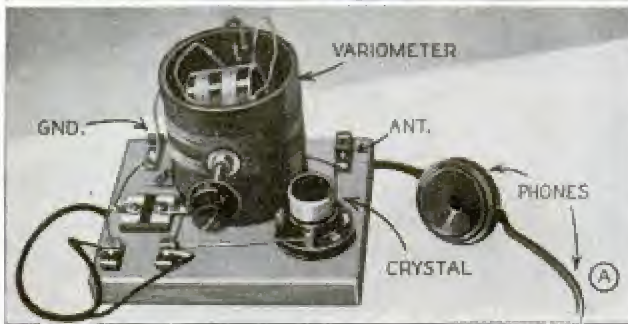


FIG. 5 RECEIVER NO. 1

POPULAR MECHANICS

THESE CRYSTAL SETS

the variometer must be flexible and long enough to permit 360 degree rotation. The rotor shaft may be extended through both sides of the stator coil form for simpler construction. Please note that the rotor coil is wound in the opposite direction from the stator coil. Both coils are close-wound and the separation between the divided windings is about $\frac{1}{4}$ inch.

The .002 mfd. fixed condenser shown is a single standard unit. If the homemade variety detailed in Fig. 3 is used, two of the completed units are assembled and connected in parallel to give approximately the same capacity. Copper foil can be obtained from reflecting insulating sheets available from building supply firms. These sheets of foil are mounted on heavy paper which is stripped off and cut to size with a safety razor blade. Alternate the foil plates and waxed paper dielectric, assemble as shown and tape each completed unit with "Scotch" tape. Mounted galena crystals and Fahnestock spring clips, are available from "dime" stores or mail order firms; suitable clips often can be salvaged from old dry batteries. The crystal may be be used with an adjustable "catwhisker" or it may be mounted as a fixed crystal detector assembled in a 4-prong tube socket, with crystal holder spot-soldered to metal disk "B" and sealed with melted wax, as detailed in Fig. 4. This assembly permits use with a 4-prong tube socket as illustrated in Fig. 5; and most commercial fixed crystals may be used in the same socket.

Both sets are assembled on well shel-lacked baseboards of the same dimensions. Set No. 2, shown in photo B, uses but one coil form, see Fig. 8, wound with the same size wire; the other parts are the same as in set No. 1 with the exception that a "book-type" homemade tuning condenser is employed, and may be connected either as shown in Fig. 7 or Fig. 9. All construction details are clearly given in Figs. 6 and 9. If sheet mica is not available for the center dielectric sheet, thin insulating fiber sheet may be used. As the knob is turned the upper plate is pulled away from the lower to vary the capacity and tune the receiver. Detailed material list R-321 is available to student beginners from Popular Mechanics radio department without charge, if desired.

Under ordinary conditions, with a good long and high outdoor antenna, and a ground connection on a nearby cold water pipe, the receiving range lies within a radius of 25 miles or more, for either set. Best distant reception is obtained at night.

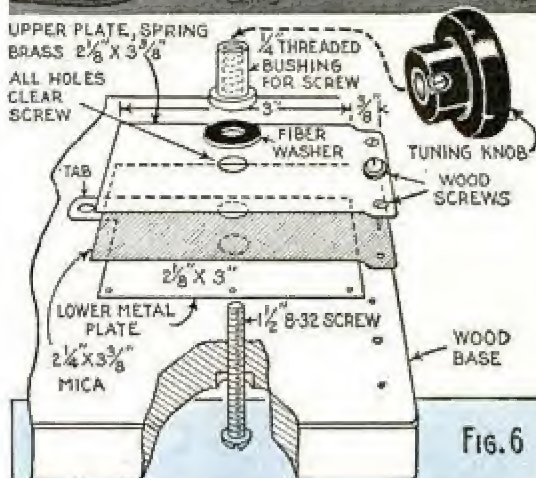
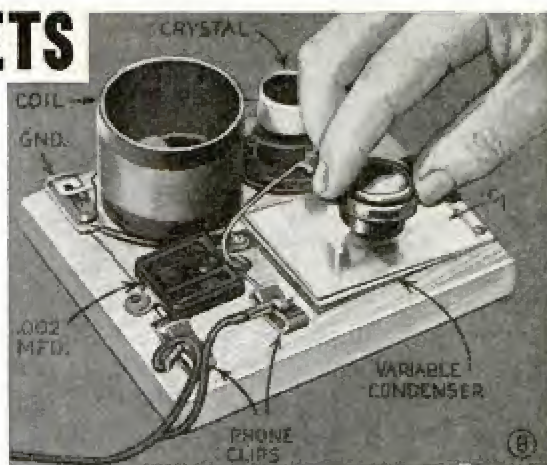


Fig. 6

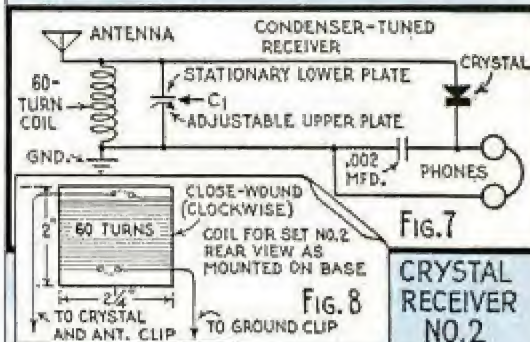


Fig. 7

CRYSTAL RECEIVER NO. 2

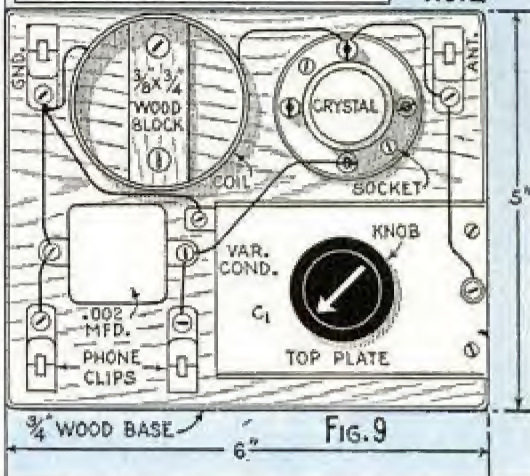
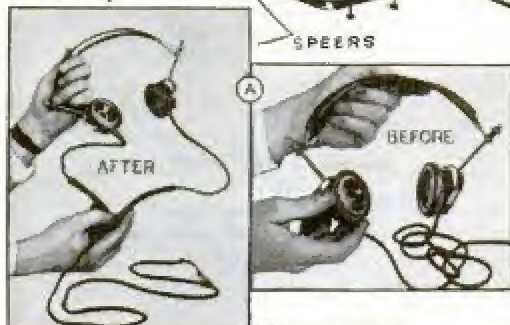


Fig. 9

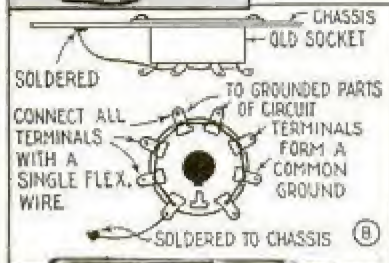
Helpful RADIO SUGGESTIONS



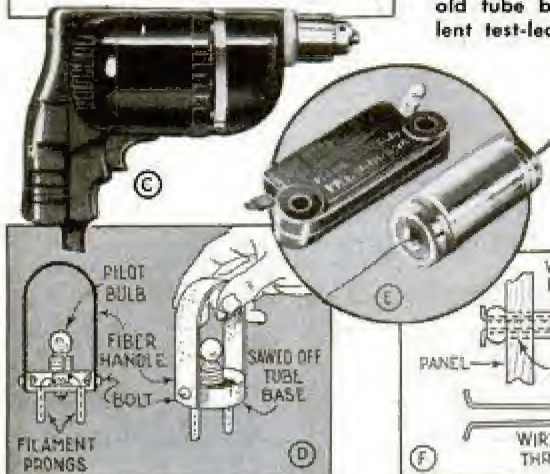
(A) Troublesome kinking headphone cords can be kept in perfect working order by means of a "non-kinking" plastic device, commonly used on telephone cords, as illustrated in the photos and sketch. A short length is twisted across the point where the cords divide. Some army and navy operators use an additional length extending down to the phone plug. (B) An old octal tube socket makes a good common ground terminal when wired as shown. When remodeling old sets, or using old chassis bases for new circuits, an extra socket is usually available for this one-point ground used in best wiring practice



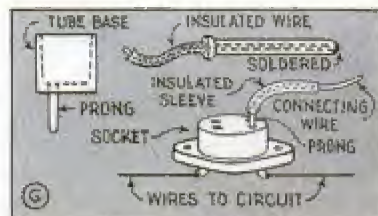
(C) This compact and lightweight $\frac{1}{4}$ in. portable electric drill has a plastic grip handle, field case and gear case. Designed for cooler operation in hot weather and in close quarters, it is claimed to permit faster work. (D) Filament voltage tester for students to test socket circuit connections to prevent tube burnouts caused by incorrect A and B voltage wiring. The 10c pilot light may burn out but expensive hard-to-get tubes are saved



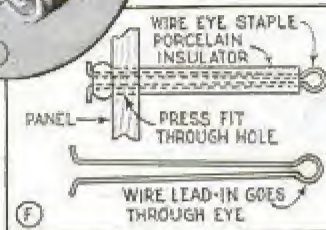
(E) Miniature oil-filled tubular-type metal-cased fixed condenser now used as alternate for the scarce flat mica type. They are claimed to meet all standard specifications for paper dielectric condensers previously used as mica replacements and are supplied in capacities from .001 to .01 mfd. rated from 300 to 800 volts. (F) Stand-off insulator for antenna lead-in, made from an ordinary porcelain tube insulator and a piece of stiff wire



(G) Prongs removed from an old tube base make excellent test-lead tip connectors



(H) Speaker is converted to a microphone for sound detecting unit; has a built-in amplifier



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This is the outfit for an old cycle fan! I thought I knew motorcycles, but the Army's teaching me plenty!

I'm riding an Indian -- as usual. What a machine! Our operations course is plenty tough but Indian's got the guts to take it -- and for easy handling and safety, give me Indian any day!

Incidentally, Indian's got some swell new improvements. It'll be a really great machine to ride when this war's over. Regards to the gang!

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BUY WAR BONDS NOW

★ ★ TO BUY AN INDIAN LATER ★ ★

Uncle Sam's Tom Thumb Navy

(Continued from page 43)

with the bow striking the concrete wall. That would disintegrate a paraffin model.

The test equipment consists of five basins—long, narrow canals—with towing carriages and dynamometers. The largest is 963 feet long, 51 feet wide, 22 feet deep. Accurate to thousandths of an inch, the carriage rail actually follows the curvature of the earth so there is no variation from end to end in gravity pull. Other basins are especially for tugboats and river craft, high speed motorboats, naval flying boats and the like. In one, turning tests are made in the dark, with lights hung on the model's bow and stern and a movie camera recording the performance. Air resistance of a ship's superstructure can be tested by towing the model upside down.

Three-fourths of the work today is secret. In the model shop, woodworkers are carving forms for antisubmarine warfare, submarine targets, minesweeping devices. The cargo ships hatching in yards throughout the nation were incubated from Carderock's wooden models. Here a foreign destroyer is being scaled in a 30-foot model, big enough for tests that will find its weaknesses in detail. There a standard warship will try out a new superstructure. And here is a new speedboat offered by a famous American designer, its hull shape suggesting that it may challenge the speed of Navy aircraft. In one workshop girls are building recognition models to teach our sailors and fliers to identify ships at a distance by a split-second glance.

The fighting Navy America is swiftly building to sweep the seven seas clean of Axis craft got its auspicious start in pine models cruising the vaulted indoor canals of Carderock.

The Red Metal of War

(Continued from page 73)

made in brazing alloys by the General Electric Company. These alloys require high temperatures for joining metals. One type of brazing alloy, widely used before the war, was composed mainly of copper, the remainder being silver and phosphorus. Now alloys with copper content as low as 16 percent are in general use. A typical alloy consists of 50 percent silver, 16 percent zinc, 18 percent cadmium and only 16 percent copper.

Plastics of one type or another are being used for such products as tubing (a principal copper product), flashlight cases,

(Continued to page 148)



HERE'S YOU IN A SUB

Like to take a good crack at a German or Jap warship—personally? Then look at the illustration below.

There's a place for you there—right inside a U. S. sub.

Of course you can't be there actually and physically. But you *are* represented.

The bonds you bought paid for that periscope.

The goods you conserved, the scrap and fats you saved, helped to release that torpedo to do its deadly work.

Your blood may save the lives of members of this very crew.

You can make this sub, or any other fighting unit, more effective. Buy more Bonds . . . conserve and

save . . . give blood . . . the more you do, the sooner you'll enjoy the richer, fuller life that's coming for us all when this war is over.

For example: Are you a camera enthusiast? Universal promises finer-than-ever cameras easily within your means, new thrills in picture-making . . . thanks to new feats of engineering achieved in furnishing the Army, Navy, Marines and United Nations with fine precision optical equipment.

And other manufacturers, in other fields, are bursting with similar promises for *their* after-Victory products, eager to bring them to you soon.

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GERMANOW-SIMON MACHINE COMPANY, Rochester, N. Y.

jewelry, pumps, household utensils, and a long list of other common items.

Is all the now precious copper shot away in bullets lost forever? By no means, according to B. B. Caddle, secretary of the Copper and Brass Research Association, who reports that a great amount of brass cartridge cases and artillery shells are being reclaimed and shipped back to the United States for remelting.

That copper has come to be regarded as the newest precious metal is the result of a situation that seems paradoxical, yet is easily explained. America has the greatest reserve of copper ore in the world, produces half the world's output, and has ten times the amount owned by Germany. But there is a copper shortage.

If that appears in the light of the unbelievable, however, Mr. Caddle explains:

"This year the United States' production of ammunition alone will require more copper than was consumed for all purposes during 1929, and that does not include the requirements of copper for Army and Navy planes and a multitude of other purposes."

And 1929 was a booming industrial year.

Plant Magic

(Continued from page 37)

similar results. It is always scientific to grow a number of untreated seeds or plants in a "control" plot so that you can compare treated and untreated plants.

The alternative method is to use the colchicine-lanolin paste for local application to plants that are already growing. Smear a small amount of paste on the plant's stalk with a toothpick. Or apply it to the growing tips or to one branch. Shortly the part that has been treated will begin to swell. A treated branch grows larger and faster than do the others. Save the seeds from this plant to learn what changes are caused in the next generation.

Roots will sprout from the stalk at the point where paste is applied. This is the experiment in which you may then remove the plant from the soil and rebury it wrong end up. The roots produced by the colchicine will grow in the earth.

Acenaphthene, available at druggists, is a nonpoisonous substance that has similar though less pronounced results. Bury a few crystals of it near a plant. A small amount of powdered sulfanilamide dissolved in water often imparts disease resistance to future generations.

One field in which chemicals and hormones have vast possibilities is in acclimatizing plants so that they will flourish

(Continued to page 150)

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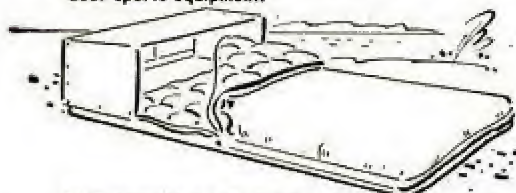
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Scarlet, Lavender, Yellow
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LEPAGE'S GLUE

**LEPAGE'S MODEL AEROPLANE GLUE
LEPAGE'S LIQUID SOLDER**

in new climates, as in introducing tropical plants into areas where heavy frosts occur. Floyd L. Cooper, a member of the Plant Culture League in California, has been able to harden coffee plants, cinchona plants from which quinine is extracted, papaya trees, and other foreign specimens so that they flourish under conditions that usually kill or stunt them.

Tests conducted at the Oklahoma Experiment Station, Stillwater, Okla., to learn the effect of synthetic hormones on domestic crops produced the following results: 838 pounds of cotton per acre against 581 pounds per acre, 42 bushels of corn per acre against 28 bushels, double production of cowpeas, an additional ton of alfalfa per acre, and 16 tons of beets per acre as compared to 5.6 tons per acre in an untreated check plot. The techniques used included seed treatment, spraying and dusting.

Seedless-fruits are created by applying growth chemicals to the flowers. Tomato and egg plant respond particularly well. The hormone replaces natural pollen in developing the fruit, and produces tomatoes that are seedless and mild in flavor.

Every day, new ways by which the new substances can help agriculture are being found. For instance, with synthetic hormones it is not necessary to fertilize fields as heavily as in the past. The hormones enable the plants to make better use of smaller quantities of fertilizer. Synthetic hormones may prove to be the agricultural discovery of the century.

Grasshoppers With Teeth

(Continued from page 79)

squadrons, and groups serving under a wing commander in each of the 48 states. Little by little the original restrictions grounding all private planes were lifted.

The early days were difficult, but with characteristic American ingenuity the original C. A. P. members carried on. That they have done a job is evidenced by the fact that the Civil Air Patrol is now an auxiliary of the Army Air Forces.

Members of the Civil Air Patrol wear regulation army uniforms with the insignia of the C. A. P., a three-bladed red propeller in a white triangle mounted on a blue circle with the letters U. S.

Military courtesy is one of the first bits of training the new recruit receives. How to wear the uniform, how and whom to salute, and how to conduct oneself in a military manner is of prime importance. Ground work in aircraft maintenance, interior guard duty, communications, navigation,

(Continued to page 152)



THE SAME CHARACTER— IN DIFFERENT UNIFORM

Once he was the center of the All-American line—now the colorful jersey, the cheering grandstands are far behind. Today he's dressed for harder, fiercer action. He's still the same character—only his appearance has changed. Plumb, too looks different in its new "service" uniform.

But Plumb quality has not changed! You'll always recognize Plumb by its character and quality—by the graceful lines of each perfectly balanced tool and by the ease and speed with which it works. Master craftsmen have designed these tools to do your job quicker and better. Plumb quality remains the same—only the fine finish has gone for the duration, eliminated by government order.

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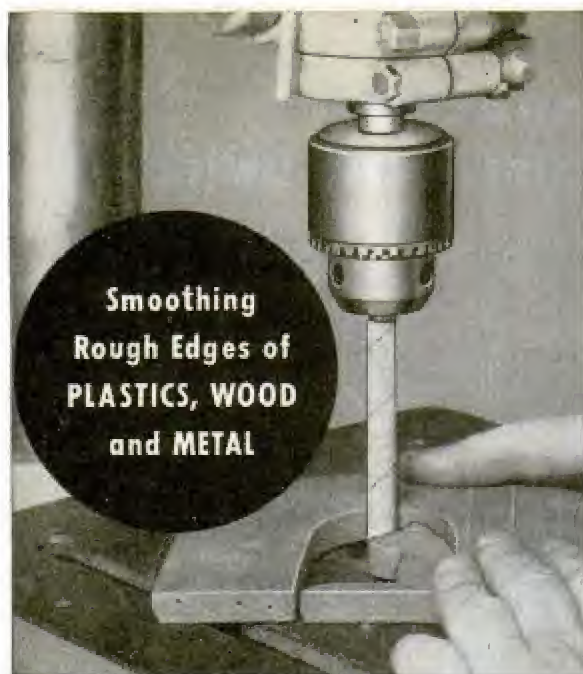


PLUMB TOOLS ILLUSTRATED, Top to Bottom: Nail Hammer, Blacksmith's Hand Hammer, Ball Pein Hammer, Half Hatchet.

Quality Comes *FIRST*
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HAMMERS • HATCHETS • AXES • SLEDGES



with a SANDING STICK and JACOBS CHUCK

Most of the interior cuts made with a scroll, jig, or fret saw require sanding or smoothing to remove irregularities. Round and half-round files and sanding sticks have been used by hand for this work, but the hand method is slow and tedious. Using a sanding stick, as illustrated, speeds up this work immeasurably and improves the quality.

Sanding sticks are easily made up in any shop. With the drill press supplying the power, both hands are free to guide the work.

To Get The Most Out of Your Drill Press or Lathe - get this New Book

The operation outlined briefly here is one of nineteen covered in detail in our new booklet just off the press. Printed in color and containing 49 illustrations, it shows how the set-ups are made, illustrates the tools used, and in some instances tells you how to make the tools themselves. If you have a workshop you will want the valuable ideas this book contains. If you are planning a shop of your own for after-the-war, you will want the booklet now to help you plan.

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meteorology, military drill, and use of small arms are also in the training program.

A false notion that exists is that by joining the C. A. P. a person will be taught to fly. This is not true. Nor does service in the C. A. P. exempt anyone from the draft. Actually, it has made many more acceptable for military service. No salaries are paid though an allowance of eight dollars a day for expenses is provided for pilots on active duty. Planes are paid for by the hour when flying government missions.

Ships range in size from the Cub on up. Nothing under 90 horsepower can be used on coastal patrol. Horsepower, however, is no guarantee against trouble. Pilot Dan Meyer and Observer Billet of Detroit learned this the hard way on patrol. Unable to make land, they pancaked into the sea near a tanker. Despite the skill with which the crash landing was made, their plane ripped open and sank almost instantly, but the crew of the tanker quickly brought them aboard. Another C. A. P. patrol plane with engine trouble was just able to make the beach of an island inhabited by wild boars. Although there was no meat shortage, there was a water shortage. Containers dropped from the air by fellow pilots broke open and spilled the precious water. Finally, another pilot dropped a cake of ice to the marooned men. Days later they were able to take off in their repaired plane.

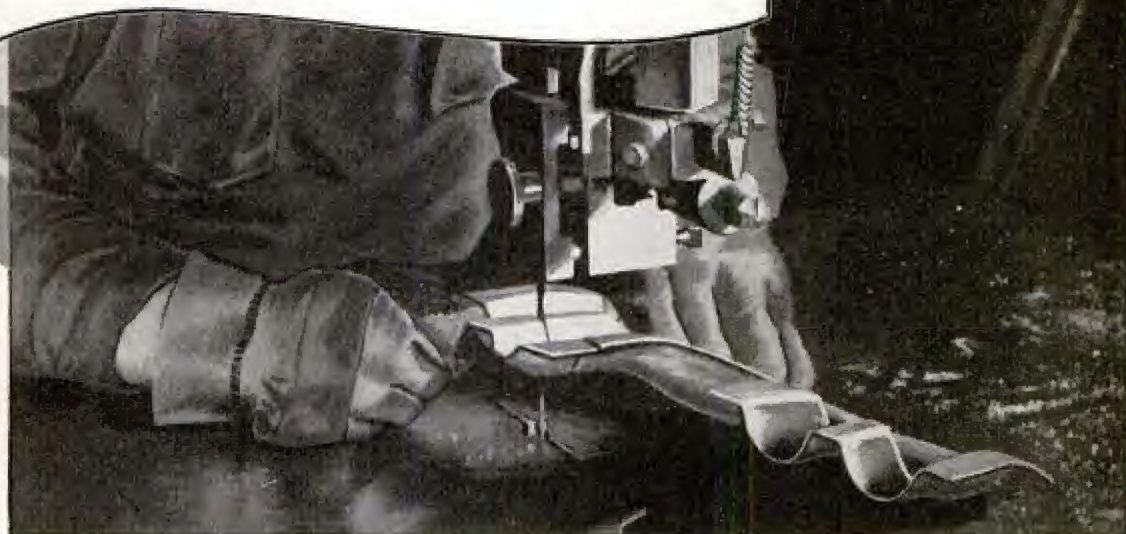
In coastal planes too small to carry a life raft, an anti-barracuda bag is provided. It is made of canvas and secured to a large inner tube. The theory is that the unlucky pilot who is forced down at sea can seek refuge by standing in this bag so that barracuda and other fish will have less opportunity to nibble on him. Standard equipment includes these bags, a knife, and life jacket. It was only through unwitting German co-operation that one group of pilots was able to make sea flights some time ago. They were grounded until eight life jackets floated up on the beach with eight German corpses. Patrol started at once.

Two C. A. P. pilots recently were awarded the Army Air Medal by President Roosevelt. These men, Hugh Sharp, Jr., and Edmond Edwards, both of Delaware, were on coastal patrol when they observed a fellow C. A. P. pilot who had been forced down in heavy seas. With their own amphibian craft partially disabled by the landing, these two men rescued the pilot and taxied through dirty weather for five hours until picked up by the coast guard.

Whether on a mission of mercy or in a death battle with a submarine, the C. A. P. is in there fighting. That's why the little planes are called "grasshoppers with teeth."

Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.



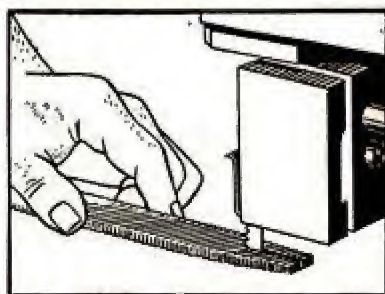
Hard Steels Cut by Heat Generated by Super High Saw Speeds

Ordinary band-saws, when operated at unbelievable high speeds up to 12,000 feet per minute, cut through hard steels and alloys by heat generated from the friction of the saw against the metal to be cut. The cutting effect is more that of burning through the metal than actual cutting. The heat generated is sufficient to melt or burn out the metal in the saw cut but not enough to draw the temper on the sides.

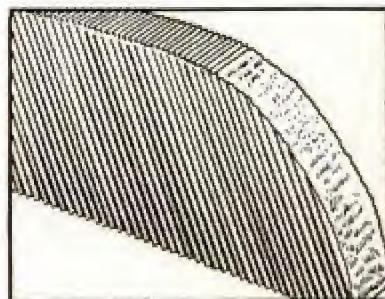
The hardness of either saw or metal to be cut is of little importance. Thin metal sheets are cut like paper, and plates up to one inch in thickness can be cut at speeds of ten inches per minute.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for Victory.

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about this method from Bell Aircraft
Corporation, Buffalo, New York.*



Proof of ability of new method
to cut hard materials is demon-
strated by operator cutting a file.



The temper of curve cut section
shown above is unaffected.

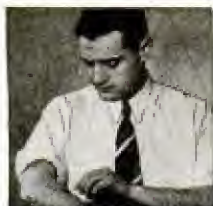
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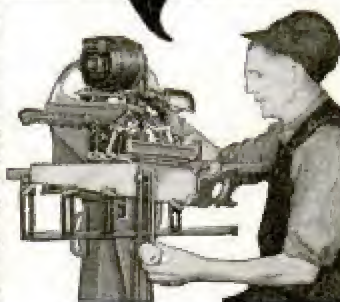
The word "Eveready" is the registered trade-mark of National Carbon Co., Inc.

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116-4 Foley Bldg., Minneapolis 13, Minn.
Please send FREE PLAN on saw filing business.

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Address.....



Winged Lightning

(Continued from page 59)

back" rides. The P-38 is a single seater but there is cramped room for a student behind the pilot's seat, on the shelf that holds the radio sets. On such a flight the instructor shows the student what to do when an engine is shot out, how he can trim the ship with the control tabs and handle it like a single-engine plane.

A P-38 pilot is not only a flier but a one-man army by himself. He may use more ammunition in a day than an infantry soldier may use during the whole war. Four .50-caliber machine guns and a 20-mm. cannon project from the nose of his ship. Under his wing he can carry a couple of demolition bombs as well as a cluster of anti-personnel fragmentation bombs. This armament equips him to attack enemy bombers or fighters, defend friendly bombers, or come right down to the ground and bomb and gun enemy installations.

There's one thing that puzzles a new pilot—his guns carry ammunition enough for only half a minute's shooting. But he soon learns that this ammunition is enough for a long fight. Because of his speed and the speed of enemy aircraft he can rarely keep a target in his gunsight for more than a fraction of a second at a time. He fires in short bursts. Some pilots have shot down half a dozen Japs on a single flight.

They Don't Stay Sunk

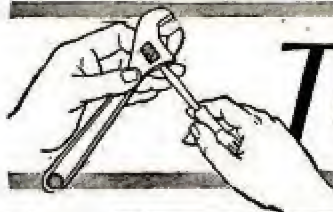
(Continued from page 87)

reasons: First, a single battleship-size floating drydock wouldn't go through the Panama Canal, and, second, it would be too easily lost. If one floating section is sunk, the others can continue to their destination.

Although American yards are turning out more ships than all the remainder of the world combined, even this production wouldn't supply the world's theaters of war without efficient repair service. Rear Admiral Emory S. Land, chairman of the Maritime Commission, told workers at the Todd Erie Basin Dry Docks, Inc., in presenting the commission's "M" flag.

He disclosed then that those workers alone had repaired 540 ships within one year's time and that one-million-plus tons of shipping have been rebuilt!

The skill of the shipwright is an ancient one in America. The first ocean-going craft, the Virginia, was built on the Maine coast in 1607, years before the Mayflower arrived. The skill that made the American flag familiar in every world port has proved itself in the nation's hour of peril.

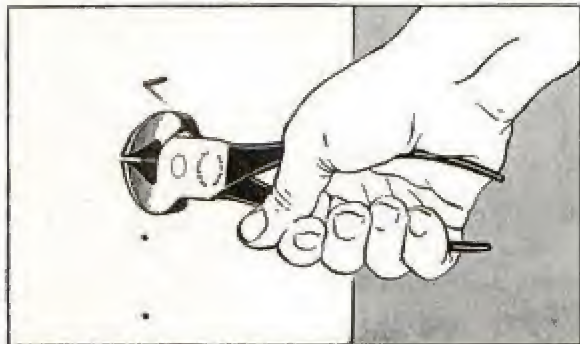


TOOL NOTES

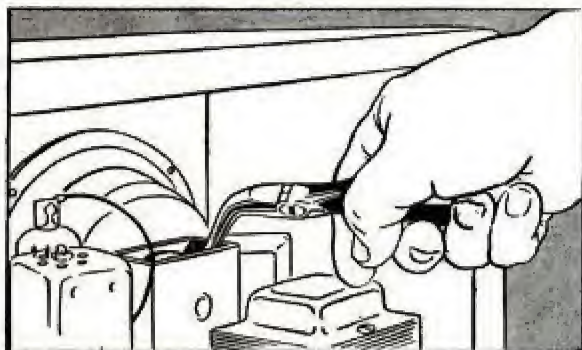
Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 14 PICKING THE PROPER TOOL FOR THE JOB

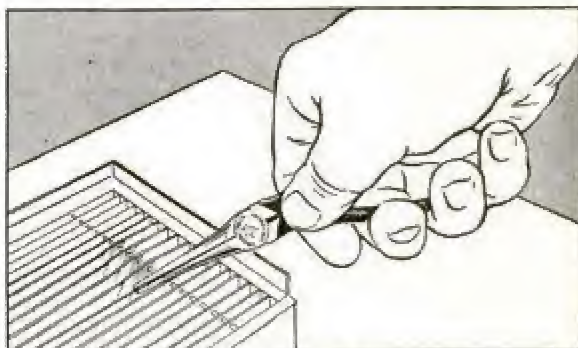
Next to knowing how to use tools, it is important to know which particular tool of a type to use for a given job or operation. With this in mind the next few issues of TOOL NOTES will cover this subject graphically.



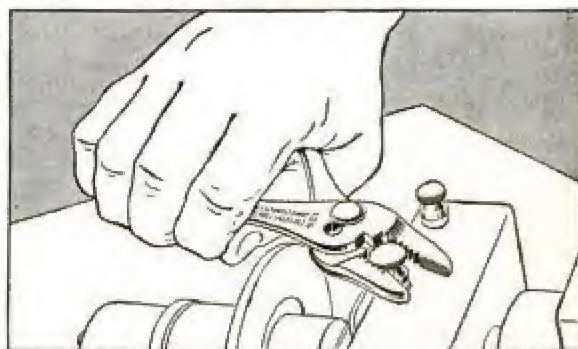
Where wire must be cut off close to a wall or other flat surface from which it protrudes, use CRESCENT END CUTTING NIPPERS. They make possible an almost flush cut because they are designed for that purpose. Example: cutting concrete form wires.



When you must work around obstructions or into tight, out of the way corners where fingers cannot reach, use CRESCENT CURVED NEEDLE NOSE PLIERS. They're designed to provide a good grip on small objects. Example: assembling radio sets.



The broad, flat, long jaws of CRESCENT'S DUCK BILL PLIERS not only provide excellent gripping power on flat surfaces, but will "reach in" and "work" where clearance is extremely limited. Example: straightening and spacing metal fins.



CRESCENT SLIP-JOINT PLIERS are a general-purpose tool, having excellent gripping power over a wide capacity range because of their adjustable jaws. Ideal for holding or turning round pieces. Example: loosening a "frozen" adjustment screw.

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This is No. 14, in Crescent's TOOL NOTES Series. These informative advertisements providing practical information for users of hand tools, are available either punched to fit a standard 3-ring binder or suitable for bulletin board and classroom use. Coupon request will receive prompt attention.

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Details gladly furnished.

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1089 Royalston Ave.

Minneapolis, Minn.

How Japan Will Be Defeated

(Continued from page 25)

sufficient supplies to keep China in the war.

The northern route via the Aleutians is a long haul, and the Japanese have only recently evacuated Kiska Island, putting us in full control of the area. The tentative bombing raids made on Paramushiro, Japan's most northern base in the Kurile chain of islands, may be preliminary to an attack in force. It would be possible to work down the Kuriles and eventually be in position to launch attacks on the main Japanese islands. This method would have the advantage of utilizing the shortest line of communication between the United States and any Japanese objective, but the Japanese Navy would have to be reckoned with. Too much confidence should not be placed in the use of Siberian bases. The matter of supplying them with gas, oil, bombs, and other material is difficult. Perhaps it was for a similar reason that the raid on the Ploesti oil fields was made from Egypt rather than a Russian base which would have cut some 700 miles from the 2,400 miles that had to be flown.

The difficulty of jumping from island to island has been demonstrated in the Guadalcanal and Munda campaigns. We were inexperienced in combat, and for a time had difficulty in putting supplies into Guadalcanal, but there was no such alibi for Munda where it required more than a month for a vastly superior force to knock out some 5,000 Japanese.

What can be expected when we tackle Rabaul or Truk where the Japanese have had ample time to develop strong defenses, and can be depended on to offer strenuous resistance? Such a campaign can be successfully waged, but the time and effort necessary can be put to better use. An out and out attack on the Philippines will result in a major campaign that will ravish the archipelago from end to end.

A war of attrition has been underway since the beginning of the war with beneficial results. Japan has lost more than 500 ships of various categories, over 200 being merchant vessels. Most of its carrier strength has been sunk or severely damaged. Several battleships, more than 40 cruisers, and destroyers by the dozen have gone down. In the Solomons since June 30 of this year 6 or 7 cruisers and 15 to 17 destroyers were accounted for. This toll is telling. In place of cargo ships the Japanese have now begun to use small barges where there is danger of attack.

Reports have been circulated that a

(Continued to page 158)

GROGGY

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It's easy to decide what battery to buy. Be guided by the experts who select batteries for the world's toughest transportation jobs. A million-mile trans-ocean flying record has just been established by a Pan-American Clipper equipped with Auto-Lite batteries.

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"Million-Mile"

Clipper uses Auto-Lite Batteries for all its ocean-spanning flights.



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With full WPB approval, we stopped making all large sizes and fixed our sights on wheels 3" in diameter and under.

We worked around the clock, 24 hours a day, and in a short time were able to fill orders on time—And, our central location cuts time in transit. Today, there is no waiting. With the Army-Navy E at our mast-head, we are going full speed ahead.

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8mm CAN and REEL...both **39**

WRITE FOR CATALOG
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dearth of rice in Japan has been caused by insufficient shipping to transport this staple from Burma and Indo-China. The war of attrition is working, but the Japanese still fight.

A direct attack on the Japanese homeland sounds chimerical, but perhaps it is the quickest way to win. However, it cannot be undertaken until the Japanese fleet is out of the way.

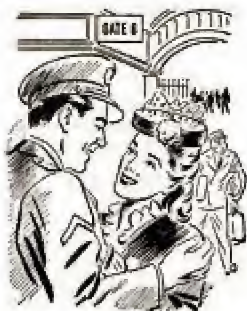
Admiral Ernest J. King, Commander-in-Chief of the United States Navy, was recently reported as having forecast powerful and crippling blows on strategic Japanese positions in the Pacific. He remarked that our operations in the Pacific have been more than holding efforts in that they were offensive in principle. He then went on to say that the plan is being followed to undertake further offensive operations designed to cramp the enemy's communications and inflict material damage.

Between the lines of this statement can be read the basic plan of campaign that probably will be followed. The first objective is the Japanese fleet and air force. Attacks on widely separated Japanese positions such as Rabaul, Paramushiro, and Burma can be developed into simultaneous campaigns. The defense of any of these areas will require all the support that can be afforded by the Japanese Navy and air force. In other words it is expected that these arms will be forced to give battle. Such was one of the unheralded objectives of the Guadalcanal campaign, and the resultant destruction of Japanese planes and naval units was in accordance with expectations.

It has been estimated that by the beginning of 1944, the Allies can muster in the Pacific a naval force of about seven times the strength of Japan's in most categories. This strength will permit every point taken under attack by the Allies to be served by a naval force strong enough to handle whatever disposition of forces Japan makes of its navy. If the Japanese decide to support with their entire navy any one threatened area at the expense of the others, the result will be one big bag of Japanese ships for the Allies. If Japan disperses its fleet, the several forces will be dealt with separately. Should Japan desert its outposts by withdrawing its fleet to the security of home waters, then one or another of the several Allied campaigns can be pushed to conclusion. Japan will be virtually blockaded by disruption of its lines of communication, and supplies without limit can be poured into Chinese ports.

If the Japanese "save face" by sending

(Continued to page 160)



Bill will remember that smile...

... it will make him a better fighting man ... because far away, remembering it, Bill will think of his family safe and secure at home.

This winter thousands of servicemen like Bill won't be here to enjoy the comforts of their homes. But they are mighty glad they insured those comforts by purchasing Perfection Oil Heaters, Water Heaters and Ranges. Bill and the others know that Perfection Oil-burning appliances are built to *last*—to give economical, dependable service for the duration and long afterwards.

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Forces ... materials into which we're putting the same fine quality that has made the name Perfection a symbol of dependability to families like Bill's. But the government has authorized us to manufacture also a *limited number of* Perfection Portable Oil Heaters and Water Heaters to meet *essential* civilian needs at home.



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A limited quantity of these low-cost Utility Room Heaters—and also Perfection-made Puritan Water Heaters—are now on sale at your nearby Perfection Dealer's. He will be glad to assist you in making application for a purchase certificate, but please do not apply if your present Perfection Oil Range or Heater can be repaired.

Shortly after the first of the year, your Perfection Dealer may have Perfection Stoves and Ranges for sale. Meanwhile, you will find a complete line of Perfection WICKS and REPLACEMENT PARTS at his store. Remember that only genuine Perfection Wicks and Replacements will insure you fine, long-lasting Perfection service.

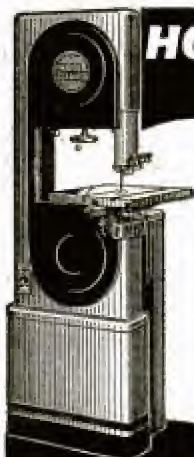
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Give constant speed to any make of auto or truck engine, regardless of load changes, when used for power. Fully guaranteed. Simple instructions. Oil ring bearing \$13.00. Ball bearing \$19.50. Prepaid. Montreal branch, 7546 Wiseman St. Latin Amer. East Asiatic Co. Free circulars. **CANDEE, 2641-M S. Hill, Los Angeles-7**

their fleet out to destruction, it will be possible to effect Allied landings in Japan. We have learned how to handle such matters, and fighting across the cleared fields of Japan is to be preferred to the muck, insects, and heat of the tropics, and should incur no greater loss in personnel, perhaps less.

All we need to permit us to initiate a campaign that will end with a parade of triumphant Allies down Tokyo's Ginza is control of the sea and air in the vicinity of the Japanese Archipelago.

(The opinions contained in the above article are those of the writer and are not to be considered as reflecting the views of the Navy Department or of the naval service at large.)

Blueprint for Tomorrow

(Continued from page 5)

Looking ahead and being dissatisfied with what you are doing is most essential. Keep going even though progress is slow. Anything can pass a thing that is standing still.

Research is really nothing more than the fundamental art of sample making. The only danger I think we have in the postwar era will be a lack of understanding between engineering and management as to the essentials of long-range research and sample-making.

We have got so systematized that we don't understand that getting ideas cannot be run on a mass production basis. If we don't get that out of our heads, we are going to weaken the very position we have attained today. You cannot budget long-range research.

Some day we are going to get out a vote of thanks to the Army and Navy engineers for the job they did during peacetime—when they didn't have any money because everybody knew there wasn't going to be another war.

They made samples—knowing just as well as you and I that they weren't necessarily the best samples in the world—but they were samples. They had been run. Our big progress when war came was due to the fact that we had those working samples to start from.

If you can get people to take a long-range look at what can be accomplished through research and engineering, and if you can get an understanding between management and research, you can write your ticket for almost any kind of a world you would like to have, and I think you will get it.

(To learn where to buy commercial products described in these pages, see the index.

Your Long Distance call may have gone to New Guinea

Telephone lines are the life-lines of an army. Bell System men and materials are helping to keep those lines unbroken on many battlefronts.

So if a Long Distance call gets delayed once in a while, you know there's a good reason.

The additional equipment that could be used here is serving the soldiers over there.

BELL TELEPHONE SYSTEM



U. S. Army Signal Corps installing switchboard in New Guinea

**WAR NEEDS
THE WIRES**

If the Long Distance circuit you want is busy — and your call isn't really urgent — it will help if you will cancel it.

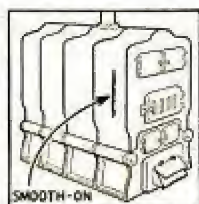
If it must go through, we'll appreciate your co-operation when the operator says: "Please limit your call to 5 minutes."



HOW TO ...

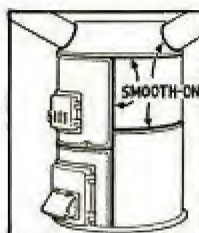
Save Fuel

THIS WINTER
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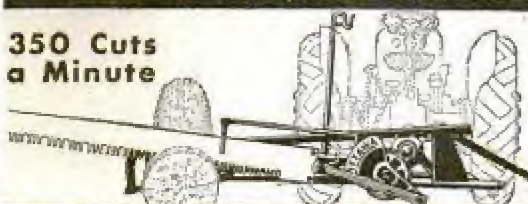
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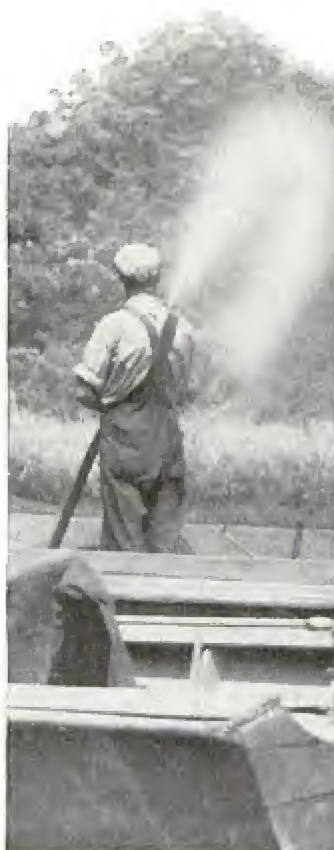
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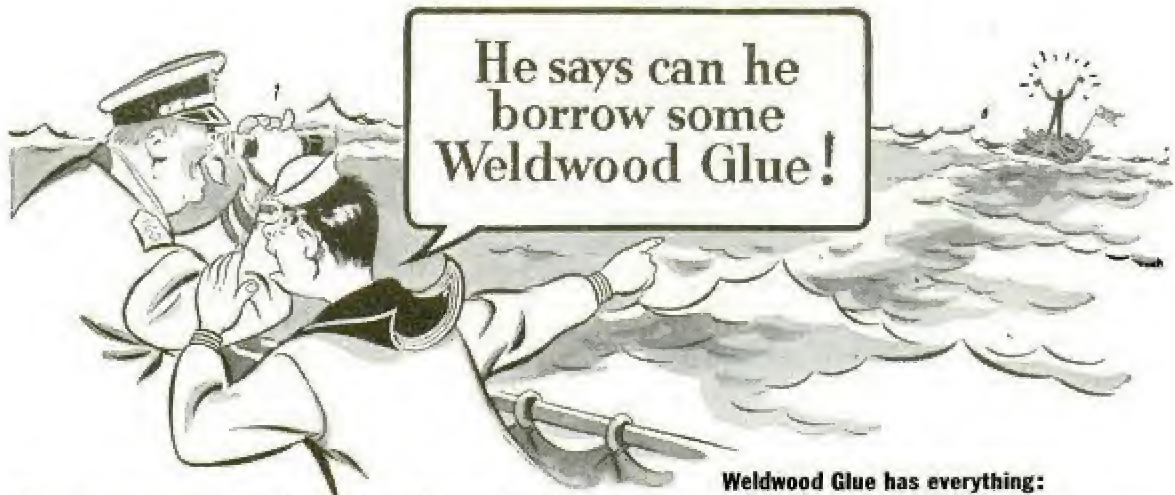
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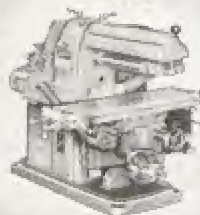
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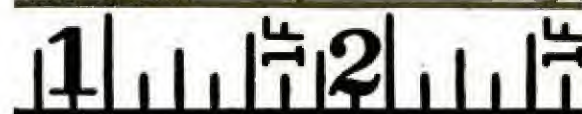
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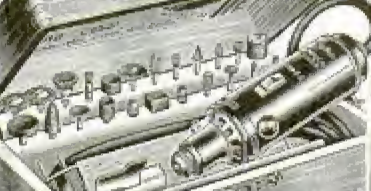
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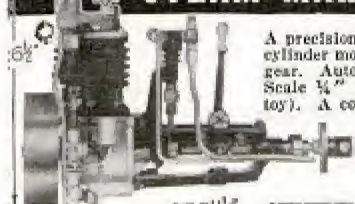
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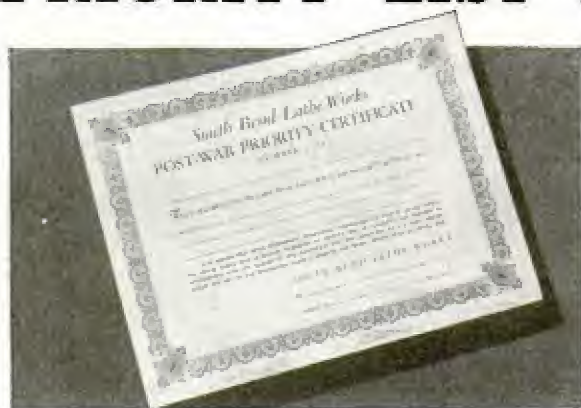
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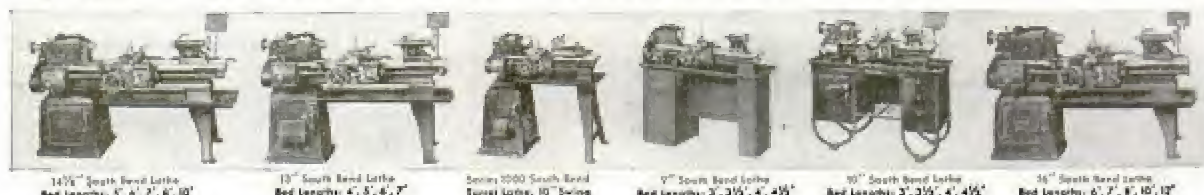
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14 1/2" South Bend Lathe
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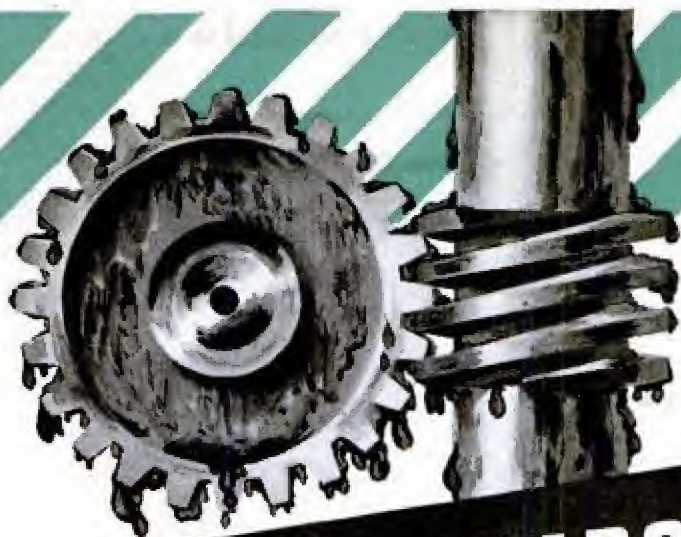
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Turret Lathe, 10" Swing

9" South Bend Lathe
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He doubles in lead,
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